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EDITORIAL

CEYLON'S SPICE TRADE

A survey of the production of spices in the Island is at the present time being undertaken with the idea of seeing what this production is, what opportunities there may be of improvement and increase in the industry, and what it is possible to do by supplying periodical information upon the condition of the various crops with regard to quantity and quality. The last information has been especially asked for by the spice industry itself.

Ceylon's export trade in spices is of the value of some ten million rupees annually. When a study of the import spice trade is made the most striking fact is the large sum annually sent out of the Island for commodities that could in many cases be produced at home. Especially prominent amongst such articles are spices used in the preparation of curries for the home production of which one would expect a natural incentive. Upon such imports Ceylon spends annually over five million rupees most of which is upon chillies, turmeric, cumin and coriander seeds.

The value of the export industry is in the main made up by the two commodities cinnamon and arecanut. Cinnamon in the form of bark, chips, or, oil distilled from any part of the shrub, usually the leaves, brings in some four and a half million rupees. The cultivation of cinnamon in the Island is an ancient one. Prices in the past year fell lower than they have been for nine years. The industry at present presents, unfortunately, a somewhat uncertain outlook. The chief markets in order of importance are South America, Spain, the United States of America, Germany, and the United Kingdom.

Arecanuts, the favourite masticatory stimulant of our Indian neighbours, bring in some three million rupees yearly, and the demand is an increasing one. Export elsewhere than to India is insignificant. Almost half of these nuts would seem to come from the Sabaragamuwa Province. One point in Ceylon's favour in the production of arecanuts is that in the major part of the consuming country this crop will not grow. The areca palm is slow to bear, but the crop is a profitable one, and might perhaps with advantage be more generally planted.

Cardamoms to the value of some three quarters of a million rupees are annually exported. The greater part of the trade is with Europe but Japan has recently been increasing her takings. The cardamom plant belongs to the same family as does the ginger plant. There are different varieties of cardamoms, the produce of which is differently graded and valued by the purchasers. There are false cardamoms too derived from a totally different genus of plants.

The export of black pepper last year was over five thousand hundredweights valued at over a quarter of a million rupees. This crop should be capable of considerable expansion in the Island. Pepper vines can be planted in the shade at the foot of many trees and they begin to bear in their third year and may continue to do so for twenty-five years or more.

A small annual export trade is also done in nutmegs, mace and cloves. Our trade in nutmegs would seem to be with India. Ceylon's nutmeg trade is of small value but it again could be increased, the fact that the tree is slow to bear, however, is somewhat against it as a crop.

A NOTE ON THE DESTRUCTION OF THE NESTS OF MOUND-BUILDING TERMITES

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THE mounds formed by certain termites, often attaining a height of several feet, are a characteristic feature of the landscape in most parts of Ceylon below an elevation of 4,000 feet. They consist of earth removed by the workers in the course of their subterranean excavations and the particles of earth are cemented together with salivary and anal discharges to form a composition which is extremely hard and durable. Large mounds indicate that the underground nests are of considerable age and the subterranean workings extensive.

When these mounds are constructed on arable land they interfere with routine cultural operations as they do with the mowing of grass when they occur on lawns. They are a nuisance on tea estates as they are often erected alongside tea bushes thus affecting their normal spread and development. The termites themselves are not primary pests of living plants and visit them only to feed upon such dead or diseased bark or wood as they may contain.

So far as is now known the mound-building habit is confined to three local species of termites *Hypotermes obscuriceps*, *H. marshalli* and *Cyclotermes redemanni*, but there are a large number of Ceylon termites which nest in the soil without forming a superstructure. In the case of the latter species it is extremely difficult to locate the main headquarters of the colonies and, consequently, their destruction is a very difficult matter.

The habit, followed by certain species, of erecting conspicuous mounds has the advantage of indicating the position in which the royal cell, around which the activity of the nest centres, may be looked for. It may be anticipated to lie about eighteen inches below the level of the surrounding ground immediately in the centre of the area covered by the base of the mound. Surrounding the royal cell, usually within a radius of about two to three feet in a large nest, are numbers of smooth-walled chambers which are packed with a friable sponge-like comb upon which is cultivated the fungus food for the young upon hatching from the eggs. The eggs are transported from the royal chamber as soon as they are deposited by the queen and they are at once conveyed to, and deposited in, the fungus combs which have been prepared for their reception.

There is a prevalent local belief that the death of the royal pair will terminate all further activity in that particular nest and it is the practice on some estates to pay as much as Re. 1-00 for every queen collected. When the royal cell has been located and removed further work on the nest is abandoned in the belief that the orphaned termites will perish. There is, however, no foundation for this current view and the removal of the original founders of the colony is an event which merely results in some temporary inconvenience to the members which remain. Arrangements are at once made to meet this situation and in a short time substitute royalties are produced to continue the population of the community.

It is necessary, therefore, in order to insure the destruction of a termite nest to exterminate the entire colony as well as the fungus combs upon which the eggs are situated. The young, upon hatching, are thus deprived not only of their food but also of the care of the older members of their community which they require in the early stages of their lives.

When the headquarters of a subterranean termite colony has been located its destruction can be effected in several ways. Fumigation with carbon bisulphide is a certain method but it is costly on a large scale. Fumigation with Cyanogas, liberated by the action of soil moisture on calcium cyanide when driven into the termite workings by means of a special force pump, is effective when the powder is fresh, but not otherwise. A method which has been practised with much success is the introduction, into the nests, of fumes generated by burning arsenic and sulphur in an apparatus consisting of a combined furnace and pump. The apparatus is costly and the method somewhat cumbersome for general use.

A method of destroying the nests of mound-building termites which has proved very successful in local tests is as follows and is recommended for extended trial. The mounds are first levelled to the ground if they form an obstruction which it is desired to remove. This may be effected with pickaxe and mamoty but if the mounds are large their demolition may be accelerated by blasting. A series of holes should then be driven into the area previously covered by the mound with the aid of an alavangoe, the depth of the holes being about 18 inches and their number depending upon the area concerned. In the writer's experience, the diameter of a large mound in Ceylon rarely exceeds eight feet at the base, but the average diameter may be considered to more nearly approximate half this width. As the ground has been considerably undermined little resistance will be offered to the passage of the alavangoe. One hole should be made in the centre of the area previously occupied by the mound. This

operation is not always necessary as a large hole will often be found in this situation being the entrance to the ventilating flue with which most mounds are provided to supply air to the subterranean abodes of these species of termites. A circle of holes should then be made around the centre about 18 inches apart and about equidistant between the centre and the circumference of the area to be dealt with. Into each hole should then be poured, through a long-necked funnel, one ounce of petrol, the hole being immediately plugged with well-rammed soil to prevent the escape of the petrol vapour. At the present price of petrol (Re. 1-50 per gallon) this treatment would cost one cent per hole for material, the total cost of treating a nest depending upon its size. An average-sized nest should not require more than 10-12 oz. of petrol and a large number of nests can be treated daily by one man providing that they are not situated too far apart. The cost of the preparatory operation of demolishing the mounds will depend upon their size and the methods employed.

This method of treatment results in the disintegration of the fungus combs within a few days of treatment and in the trials upon which this note is founded no survivors of treated colonies have been found when the above-mentioned dosages have been applied. Large numbers of dead termites may be encountered if the examination of the treated nest is not delayed too long, and the decomposing remains of the royal pair are to be seen when the queen cell is opened.

As new colonies are being continually formed by the winged pairs of the colonizing flights, particularly after heavy showers of rain at certain seasons of the year, it is necessary that constant inspections should be made for the formation of new mounds. In the early stages the mounds can be levelled without difficulty and the nests destroyed by the injection of petrol at a few points only.

The success which has attended the experimental stages of this method of destroying the nests of mound-building termites warrants its trial on a more extended scale and reports upon the success, or otherwise, of such trials will be received with interest.

MANURIAL EXPERIMENTS WITH RICE—PART III

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THESE experiments have already been described and preliminary reports have appeared in this Journal*. The present paper reports further results and summarises all results to date. In addition general recommendations for the manuring of rice are made.

It was stated in Part I of this paper that it was intended to try other ammonium phosphates in a new series C. The results of this new series will be found in Tables I to IV. These are of considerable interest and will be discussed later. Tables V to XI summarise the results of all the trials to date.

The different series at the four stations have not all the same experimental value but even those which have been largely affected by soil heterogeneity and other causes are still of some use in indicating general manurial response. Undue importance must not be attached to the percentages figures in the Wariyapola trials. Owing to the very restricted water supply the yields of the control plots varied from 4 to $6\frac{3}{4}$ bushels per acre. These are very low yields and a small increase in yield due to the manures implies a very large percentage increase. In spite of the poor water supply at Wariyapola the response to the manures was remarkable and the increases obtained from some of the treatments were sufficient to meet their cost. It is probable that here the effect of phosphoric acid in stimulating root development gave the plants receiving this plant food an advantage throughout the whole growing period.

The effect of smaller dressings of green manure was investigated at Peradeniya during the *maha* season of 1929-30. Five and one-ton dressings of green material brought in from outside were tested and the results will be seen in Table XII. The trial satisfies the requirements of the z test. Wild sunflower, *Tithonia diversifolia*, was used to supply the green material. The one-ton dressing has given a very satisfactory increase in yield of grain. The dressing five times as great has given an increase two-and-a-half times as great. The cost of cutting and transporting green material is frequently high and it is not thought that in most places dressings of more than one ton per acre will be possible.

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DISCUSSION OF THE RESULTS

These manurial experiments have not yet been carried out for a sufficiently large number of years to allow more than general conclusions being drawn as to the results of most of the treatments tried. There is very definite evidence of the value of green manure at all stations except Labuduwa where the soil is naturally richer in organic material but even at Labuduwa when the limiting factor of phosphoric acid is added the application of green manure has been beneficial. The decomposition of the organic matter furnished by green materials, weeds and crop residues not only supplies plant food for the rice plant but also supplies carbon dioxide for the algae which are supposed to be so important in the supply of oxygen to swamp rice. Where crops occupy the land for the majority of the year (as in parts of the Central Province) or where natural weed growth is poor in quantity (as in dry districts and where fields are grazed bare by cattle) the application of at least some additional green material is important and in some places may be essential if the full benefit of applying artificial fertilisers is to be obtained.

The application of superphosphate and steamed bone meal, alone, has given economical results at all stations and it must be concluded that phosphoric acid is perhaps the most important plant food to be added to Ceylon paddy soils. It is estimated that the application of 1 cwt. of ordinary superphosphate or of 100 lb. steamed bone meal will give on average soils an increase of about 25% with a residual effect on the succeeding crop of about 12%. The addition of small dressings of sulphate of ammonia to these manures has had no effect. There is evidence, however, that with larger dressings of superphosphate additional nitrogen will be effective and it is thought that if superphosphate is applied alone for a number of years yields will fall off unless nitrogen is also given.

The addition of potash to nitrogen and phosphoric acid has had no effect and it may be concluded that applications of potash are not necessary on Ceylon paddy soils.

Apart from the effects of phosphoric acid alone, and of green manuring, the chief interest in these trials is the effect of the different ammonium phosphates. The value of this compound fertiliser has been masked at Anuradhapura owing to the high fertility of the fields. The control plots yielded at the rate of 2,568 lb. per acre which for unmanured land is a yield which compares favourably with yields in any part of the world. Some explanation of the quantities per acre of the fertilisers used in this series is necessary. Treatments 1, 2 and 4 at the time the experiment was started were based on equal costs. Prices have varied since then. Treatments 3 and 5 contained similar

amounts of nitrogen as treatment 1 on the analyses then available. The data which is available here is not exhaustive but it indicates that moderate dressings of the amonium phosphates with the wider ratio of nitrogen to phosphoric acid are generally more effective. On less fertile soil it is probable that the use of a narrower ratio ammonium phosphate is advisable.

GENERAL RECOMMENDATIONS FOR MANURING PADDY FIELDS

1. For fields which carry between crops a luxuriant weed growth and where nitrogen can be assumed to be present in sufficient amount: $\frac{3}{4}$ to 1 cwt. concentrated superphosphate followed when yields go off by $\frac{3}{4}$ to 1 cwt. of a wide ratio ammonium phosphate.
2. For fields of average fertility: $\frac{3}{4}$ to 1 cwt. of a wide ratio ammonium phosphate followed in later years by 1 cwt. of a narrow ratio ammonium phosphate.
3. For poor soils and where the above fertilisers do not succeed in maintaining yields: 1 cwt. of a narrow ratio ammonium phosphate.

Superphosphate is best applied at the final ploughing and ammonium phosphate about a day before sowing or transplanting. The addition of green manure to the above dressings is recommended unless weed growth is very large. A suitable average amount to apply is one ton per acre but even smaller amounts will be beneficial.

Diammonphos and Leunaphos tried in the new series C are not now on the market. The ammonium phosphates available are as follows:

Wide ratio - ammophos	13/46
nicifos	17/45
Narrow ratio - ammophos	20/20
nicifos	22/18

The first figures show the percentage of ammonia and the second the percentage of phosphoric acid.

Information as to the optimum dressings per acre on different soils is not yet available but it must not be assumed that the amounts mentioned above are maximum dressings. It would, however, be unwise to exceed them unless the water supply is ample and the paddy varieties are moderately stiff-strawed.

ACKNOWLEDGMENT

In conclusion, I have pleasure in expressing my thanks to my assistants in the Division of Economic Botany without whose help these trials could not have been carried out.

Table I

LABUDUWA—MAHA 1929-30

New Series C

Treatment per acre	Yield per acre based on mean of 4 plots of 1/100 acre		Yield expressed as a percentage of the control plot	Value of increased yield over control at Rs. 2/- per bus.	Cost of manures F.O.R. Colombo
	lb.	Bus. of 48 lb.		Rs. cts.	Rs. cts.
1. 104½ lb. Ammophos 16N/20 P_2O_5 (16·72 lb. N + 20·9 lb. P_2O_5)	1512	31½	210·80	33 00	9 38
2. 96½ lb. Ammophos 11 N/45 P_2O_5 (10·61 lb. N + 43·42 lb. P_2O_5)	1565	33	218·11	36 00	10 77
3. 80 lb. Leunaphos 20N/20 P_2O_5 (16 lb. N + 16 lb. P_2O_5)	1242	26	173·17	22 00	7 74
4. 76 lb. Diammonphos 21N/53 P_2O_5 (15·96 lb. N + 40·28 lb. P_2O_5	1517	32	211·49	34 00	10 95
5. 80 lb. Sulph. of Ammonia (16 lb. N) 112 lb. Superphosphate (20·2 lb. P_2O_5)	1417	30	197·56	30 00	5 00 3 75
6. Control: no Manure	717	15	100·09	—	

Standard error of the difference between means = 10·53 %

z = 1·1748

5 % point z = ·5326

Table II

LABUDUWA—NEW SERIES C. YALA 1930

Residual Effects

Treatment per acre	Yield per acre based on mean of 4 plots of 1/100 ac.		Yield expressed as a percentage of the control plot	Value of increased yield over control at Rs. 2- per bus.
	lb.	Bus. of 48 lb.		Rs. cts.
1. 104½ lb. Ammophos 16 N/20 P_2O_5 (16·72 lb. N + 20·9 lb. P_2O_5)	1345	28	118·76	9 00
2. 96½ lb. Ammophos 11 N/45 P_2O_5 (10·61 lb. N + 43·42 lb. P_2O_5)	1612	33½	142·38	20 00
3. 80 lb. Leunaphos 20 N/20 P_2O_5 (16 lb. N + 16 lb. P_2O_5)	1237	25¾	109·27	4 50
4. 76 lb. Diammonphos 21 N/53 P_2O_5 (15·96 lb. N + 40·28 lb. P_2O_5)	1437	30	126·93	13 00
5. 80 lb. Sulphate of Ammonia (16 lb. N) 112 lb. Super (20·2 lb. P_2O_5)	1327	27¾	117·22	8 50
6. Control : no manure	1132	23½	100 00	—

Standard error of the difference between means = 15·94 %

z = ·0790

5% point z = ·5326

Table III

ANURADHAPURA—MAHA 1929-30

New Series C

Treatment per acre	Yield per acre based on mean of 6 plots of 1/100 acre		Yield expressed as a percentage of the control plot	Value of increased yield over control at Rs. 2/- per bus.	Cost of manures F.O.R. Colombo
	lb.	Bus. of 48 lb.		Rs. cts.	Rs. cts.
1. 104½ lb. Ammophos 16/20 (16·72 lb. N + 20·9 lb. P_2O_5)	2777	58	108·11	9 00	9 38
2. 96½ lb. Ammophos 11/45 (10·61 lb. N + 43 42 lb P_2O_5)	2908	61	113·23	15 00	10 77
3. 80 lb. Leunaphos (16 lb. N + 16 lb. P_2O_5)	3005	63	117·01	19 00	7 74
4. 76 lb. Diammonphos (15·96 lb. N + 40·28 lb. P_2O_5)	3102	65	120·77	23 00	10 95
5. 80 lb. Sulphate of Ammonia (16 lb. N) 112 lb. Super (20·2 lb. P_2O_5)	2793	58 1/5	108·76	9 40	{ 5 00 { 3 75
6. Control : no manure	2568	53 1/2	100·00	—	—

Standard error of the difference between means = 5·45 %

z = 0 5370

5 % Point z = 0·4783

N.B —Results of residual effects were spoiled due to floods.

Table IV

WARIYAPOLA—MAHA 1929-30

Series C

Treatment per acre	Yield per acre based on mean of 2 plots of 1/100 acre		Yield expressed as a percentage of the control plot	Value of increased yield over control at Rs 2/- per bus.	Cost of manures F.O.R. Colombo
	Lb.	Bus. of 48 lb		Rs. cts.	Rs. cts.
1. 104½ lb. Ammophos 16/20 (16·72 lb. N + 20·9 lb. P_2O_5)	585	12	216·66	12 00	9 38
2. 96½ lb. Ammophos 11/45 (10·61 lb. N + 43·42 lb. P_2O_5)	510	11	194·44	10 00	10 77
3. 80 lb. Leunaphos (16 lb. N + 16 lb. P_2O_5)	510	11	194·44	10 00	7 74
4. 76 lb. Diammonphos (15·96 lb. N + 40·28 lb. P_2O_5)	500	10	185·18	8 00	10 95
5. 80 lb. Sulphate of Ammonia plus 112 lb. Superphosphate (16 lb. N + 20·2 lb. P_2O_5)	550	11½	203·70	11 00	5 00 3 75
6. Control : no manure	270	6	100·00	—	—

Standard error of the difference between means = $\frac{8{\cdot}83\%}{z}$

$z = 1{\cdot}3054$

5% point $z = 0{\cdot}8097$

Table V

PERMANENT MANURIAL TRIALS

Series A

Treatment per acre	Mean yield per acre expressed as a percentage of the control plots						
	Labuduwa		Anuradhapura		Peradeniya		Wariyapola
	1928-29	1929-30	1929	1930 (double dose)	1928-29	1929-30*	1929-30
1. Control : no manure	100 00	100·00	100 00	Trials spoiled due to floods	100·00	100·00	100·00
2. ½ cwt. Sulphate of Ammonia (11·2 lb. N)	97·35	68·38	106·27		109·66	95·69	192·86
3. As in 2 plus 1 cwt. Super (20·2 lb. P_2O_5)	112·63	115·44	104·50		114·99	98·26	198·98
4. As in 3 plus ½ cwt. Muriate of Potash† (28 lb. K_2O)	111·92	118·62	111·73		114·84	102·74	164·29
5. 1 cwt. Super. (20·2 lb. P_2O_5)	114·81	109·43	108·52		113·04	109·78	236·73
6. ½ cwt. Sulphate of Ammonia plus 5 tons Green Manure‡	107·61	75·24	118·00		135·29	110·70	202·04

* Results not reliable due to floods

† Muriate of Potash was replaced by Sulphate of Potash in 1929-30 and 1930

‡ 5 tons Green Manure were reduced to 1 ton in 1929-30 and 1930

Table VI

PERMANENT MANURIAL TRIALS

Series A—Residual Effects

Treatment per acre	Mean yield per acre expressed as a percentage of the control plots				
	Labuduwa		Anuradhapura	Peradeniya	
	1929	1930	1929-30	1929	1930*
1. Control : no manure	100·00	100 00	100·00	100·00	100·00
2. ½ cwt. Sulphate of Ammonia (11·2 lb. N)	99·16	88·59	101·02	105 87	97·64
3. As in 2 plus 1 cwt. Super. (20·2 lb. P_2O_5)	107·01	108·89	106·60	124·58	97·98
4. As in 3 plus ½ cwt. Muriate of Potash† (28 lb. K_2O)	83 34	110·71	98·98	146·65	108 94
5. 1 cwt. Super (20 2 lb. P_2O_5)	101·51	109·39	98·23	129·33	112·48
6. ½ cwt. Sulphate of Ammonia plus 5 tons Green Manure‡	101·96	82·53	106·33	143·02	97·81

* Results not reliable due to floods

† Muriate of Potash was replaced by Sulphate of Potash in 1929-30 and 1930

‡ 5 tons Green Manure were reduced to 1 ton in 1929-30 and 1930

Table VII

PERMANENT MANURIAL TRIALS

Series B

Treatment per acre	Mean yield per acre expressed as a percentage of the control plots						
	Labuduwa		Anuradhapura		Peradeniya		Wariyapola
	1928-29	1929-30	1929	1930	1928-29	1929-30*	1929-30
1. Control: no manure	100·00	100·00	100·00	Trials were spoiled due to floods	100 00	100·00	100 00
2. 91 lb. Steamed bone meal (2·73 lb. N+20 lb. P_2O_5)	171·99	131·89	108·96		104 65	103·81	280·28
3. As in 2 plus 42·35 lb. Sulphate of Ammonia (11·2 lb. N+20 lb. P_2O_5)	160·81	125·28	104·32		—	—	291 55
4. As in 2 plus 5 tons green manure †	171·53	175·39	107·88		128·17	106·68	274·64
5. 1 cwt. Superphosphate (20·2 lb. P_2O_5)	169 91	149·65	117·46		—	—	242·25
6. As in 5 plus 5 tons green manure †	190·90	176·53	109·27		—	—	291·55

* Results not reliable due to floods

† 5 tons green manure were altered to 1 ton in 1929-30 and 1930 — except at Anuradhapura

Table VIII

PERMANENT MANURIAL TRIALS

Series B—Residual Effects

Treatment per acre	Mean yield per acre expressed as a percentage of the control plots				
	Labuduwa		Anuradhapura 1929-30	Peradeniya	
	1929	1930		1929	1930*
1. Control : no manure	100·00	100·00	100·00	100 00	100·00
2. 91 lb. Steamed Bone meal (2·73 lb. N + 20 lb. P_2O_5)	115·33	115·04	108·12	118·72	106·07
3. As in 2 plus 42·35 lb. Sulphate of Ammonia (11·2 lb. N + 20 lb. P_2O_5)	131·69	108·48	110·31	—	—
4. As in 2 plus 5 tons green manure †	127·47	112·00	100·39	144·97	115·68
5. 1 cwt. Superphosphate (20·2 lb. P_2O_5)	112·00	114·56	112·99	—	—
6. As in 5 plus 5 tons Green Manure †	139·52	103·68	106·99	—	—

* Results not reliable due to floods

† 5 tons Green Manure were altered to one ton in 1929-30 and 1930—excepting at Anuradhapura

Table IX

PERMANENT MANURIAL TRIALS

Series C

Treatment per acre	Mean yield per acre expressed as a percentage of the control plots			
	Labuduwa 1928-29	A'pura 1929	Peradeniya	
			1928–29	1929-30*
1. 93 lb. Ammophos (15 lb. N + 18·6 lb. P_2O_5)	169·40	. 108 81	125·44	85·87
2. 75 lb. Sulphate of Ammonia plus 104 lb. Superphosphate (15 lb. N + 18·6 lb. P_2O_5)	162·98	106·28	115·02	108·07
3. Control : no manure	100·00	100·00	100·00	100·00

* Results not reliable due to floods.

Table X

PERMANENT MANURIAL TRIALS

Series C—Residual Effects

Treatment per acre	Mean yield per acre expressed as a percentage of the control plots			
	Labuduwa 1929	A'pura 1929-30	Peradeniya	
			1929	1930*
1. 93 lb. Ammophos (15 lb. N + 18·6 lb. P_2O_5)	169·40	100·99	97·89	86·93
2. 75 lb. Sulphate of Ammonia plus 104 lb. Super (15 lb. N + 18·6 lb. P_2O_5)	143·17	98·89	104·22	83·33
3. Control : no manure	100·00	100·00	100·00	100·00

* Results not reliable due to floods.

Table XI

PERMANENT MANURIAL TRIALS

New Series C

Treatment per acre	Mean yield per acre expressed as a percentage of the control plots				
	Labuduwa		Anuradhapura		Wariyapola
	Manured 1929-30	Residual 1930	Manured 1929-30	Residual 1930	1929-30
1. 104½ lb. Ammophos 16 N/20 P_2O_5 (16·72 lb. N + 20·9 lb. P_2O_5)	210·80	118·76	108·11	Trials were spoiled due to floods	216·66
2. 96½ lb. Ammophos 11 N/45 P_2O_5 (10·61 lb. N + 43·42 lb. P_2O_5)	218·11	142·38	113·23		194·44
3. 80 lb. Leunaphos 20 N/20 P_2O_5 (16 lb. N + 16 lb. P_2O_5)	173·17	109·27	117·01		194·44
4. 76 lb. Diammonphos 21 N/53 P_2O_5 (15·96 lb. N + 40·28 lb. P_2O_5)	211·49	126·93	120·77		185·18
5. 80 lb. Sulphate of Ammonia 16 lb. N 112 lb. Super (20·2 lb. P_2O_5)	197·56	117·22	108·76		203·70
6. Control : no manure	100·00	100·00	100·00		100·00

Table XII

MAHA 1929-30

Peradeniya Paddy Station—Green Manure Experiment—Grain weights

Treatment per acre	Replications (Yield in lb.)				Total	Yield per acre		C=100%	Value of increased yield over control at Rs. 2-00 per bus.
	a	b	c	d		Lb.	Bus. of 48 lb.		
1. One ton Green Manure	15·7	16·0	25·1	22·2	79·0	1975	41¼	140·82	Rs. cts. 24 00
2. Five tons Green Manure	23·5	22·5	36·4	26·9	109·3	2732	57	194·83	55 50
3. Control	15·3	7·9	21·6	11·3	56·1	1402	29¼	100·00	—
Block Total	54·5	46·4	83·1	60·4	244·4				

Standard error of the difference between means=8·94%

z=1 6491

5% point z=0·8188

RESEARCH WORK ON RUBBER CULTIVATION IN 1929*

Economy.—Luytjes and Tergast gave a third report on the situation of the native rubber in the Netherlands-Indies, covering the year 1928 and the first five months of 1929.

The exports of native rubber amounted in 1928 to 129,178 tons wet rubber (equivalent: 90,962 tons dry rubber) against an equivalent of 98,683 dry rubber in 1927. This diminution has to be attributed to the low prices in 1928. Many of the imported labourers left the rubber districts in this year—only in Djambi many of the imported Javanese coolies remained—while the tapping by the owners and the members of their families and the employment of local labourers increased. This change in the labour conditions brought a lowering of the expenses and the adaptation to the low prices of rubber. It may be expected, that in most districts tapping will go on regularly as long as prices do not fall lower than one shilling per lb.

Only in those districts, where the population has other important means of existence (especially in Tapanuli, west coast of Sumatra and Bangka) the decrease in production sets in at a higher market price.

The production that would be obtained if the native fields were all regularly tapped may be estimated at 135,000 tons for 1929. The area which is not yet in production may be estimated at two to three times the present area in production. The young fields have been planted from 1924 up to 1929 and are gradually getting into production. Lately planting of new fields has been done less on account of the low prices.

Another important report on native rubber in the Dutch East Indies is that of Taylor and Stephens, who visited the more important native producing districts by commission of the Rubber Growers' Association.

They point out that the planting of rubber by the natives rose to fever height in the boom years 1925-26 and has steadily declined since.

The stand of the trees is dense and large yields are obtained for some years. From the evidence collected average figures that appear to be applicable are:

Table I

Age	Pounds per acre
5 years	300
6 ,, ...	400
7 ,, ...	600
8 ,, ...	700
9 years and above	800

The number of trees per acre is very large (about 375) and accordingly the yield per tree is low.

In order to enable the tapper on the 50-50 share basis, still very common in all districts, to earn at present prices what is considered a sufficient remuneration, a good yield is essential, a general average of 4 to 5 lb. per diem (more usually the latter), being the usual return. And if such yields are not capable of maintenance even by the growing practice of larger tasks, tapping the trees becomes spasmodic and finally ceases, though this is still comparatively a rare occurrence.

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* From *International Review of Agriculture* (Part 1, Monthly Bulletin of Agricultural Science and Practice) Year XXI, No. 8, August 1930.

Bark consumption is rapid and generally after about two years the renewed bark is tapped, and this second tapping is nearly always a mass of wounds. The third tapping after another couple of years is still worse. To compensate for the declining yield from the single cut, one or more additional cuts at all angles and in any promising looking spot are added. This enables large yields per acre to be maintained up to about the twelfth year of age. Taylor and Stephens estimate that the decline in yield after six to seven years of tapping is probably not less than 10 per cent per annum. "Brown Bast disease" is very common.

It is estimated that taking the amount of native rubber planting done during the period 1923-28 the proportion planted in the various years was: 1923 almost nil; 1924 10 per cent.; 1925 30 per cent.; 1926 30 per cent.; 1927 20 per cent.; and 1928 10 per cent. On this basis a forecast has been made of what appears to the investigators to be the *potential* yields for the next five years. "But so long as prices between 9d. and 1s. per lb. prevail it is not thought that the potential yield will anywhere be realised."

The estimated areas under native rubber cultivation are as follows:

Table II

	Estimated areas (in acres)		
	Old	Young	Total
Pontianak ...	53,000	159,000	212,000
Bandjermasin ...	50,000	100,000	150,000
Palembang ...	53,000	265,000	318,000
Djambi ...	70,000	140,000	210,000

The estimated *potential* outputs for the years 1929-1933 are given. That of 1933 may be mentioned here:

Table III

Estimated Potential output (1933)

Pontianak	Bandjermasin	Palembang	Djambi	Total (estimated at 70% of the whole of the native rubber in the Neth. E.I.)
Tons	Tons	Tons	Tons	Tons
51,000	34,500	77,500	47,500	220,000

Botanical Research.—Morris gave a general review of previous investigations on the *Pollination and fertilisation* of the Hevea tree. He added the results of some of his own investigations on Pilmoor Estate, Batoe Tiga, Selangor (F. M. S.)

The supposition of Heusser, that pollination with pollen of another tree of the same clone would result in a higher percentage of fertilisation than self-pollination was not confirmed; pollination between different trees of clone A 44 remained without result; the same was the case between trees of clone B 58.

In his hybridisation experiments Maas (Sumatra) obtained up to 56% of successful cross-pollinations. Heusser (Sumatra) obtained in his cross-pollination experiments very different results with different combinations of trees. With some combinations, for instance, tree No. 29 pollinated with pollen of tree No. 141 no success at all was obtained, while with other combinations cross-pollination always resulted in a rather high percentage of fertilisations. The highest percentage was obtained in pollinating tree 138 with pollen of tree 146. Schweizer (Java) obtained 18% successful pollinations and Van der Hoop (Java) in 1924 35%, in 1926 35% and 1927 6·9%.

Morris obtained the following percentages of successful cross-pollinations in the different combinations :

Table IV

Combinations					Percentage of successful cross-pollinations
A 44 ♀	X	B 58 ♂	...	...	0·4
B 58 ♀	X	A 44 ♂	...	...	1
A 8 ♀	X	A 44 ♂	...	...	6
A 44 ♀	X	A 8 ♂	...	...	3
A 44 ♀	X	D 6 ♂	...	...	18

All the percentages must be regarded as low in comparison with those obtained in Java and Sumatra.

In the second series of his experiments Morris pollinated 7 mother-trees with pollen of different other trees. Of all these pollinations including 1248 flowers of 186 inflorescences, 91 fruits were obtained with 274 seeds, of which 205 germinated.

Thus 7% were successful.

The results of Morris' experiments of 1928 can be summarised as follows :- 2290 flowers of 8 clones were pollinated; 1685 crosses gave 94 fruits, *i.e.,* 5·5 per cent. of success, and 213 seeds germinated. All the 605 self-pollinations failed.

Investigations on *correlation between vegetative characters and yield* of rubber have been carried out by quite a large number of workers, the final object being selection of high yielders.

Sanderson and Sutcliffe investigated this matter again.

In order to find out whether or not there was a close correlation between the number of latex vessel rows and the yield, the number of latex vessels in 485 trees was recorded at three different heights 5 in., 10 in. and 20 in. The average total of latex vessel rows at 5 in. was 15·27, at 10 in. it was 13·17 and at 20 in. 11·00.

For each girth increase of 4 in. at 20 in. there appears to be an average increase of one in the number of latex vessel rows. The correlation coefficient between the characters, girth and number of vessels is $+0{\cdot}44 \pm 0{\cdot}036$. This is sufficiently high to indicate a definite correlation, but not high enough to justify the assumption that trees of the greatest girth at 20 in. will also have the largest number of latex rows at that point.

A similar correlation exists between the girth at 20 in. and the yield. The correlation coefficient ($+0{\cdot}3983$) is too low to justify selection of a small percentage of high-yielding trees by girth measurement alone, but is yet sufficiently high to indicate that large girth is a desirable character, since it has some influence on the yield.

Such a correlation exists also between the yield and the latex vessel rows at 20 in. The coefficient is $+0{\cdot}46 \pm 0{\cdot}2265$.

As regards the rubber content of the latex, this varied from 16% to 38%. The coefficient of variability 14·6 is so high that volumetric determination of yield cannot be relied upon; final determination of yield should be by actual dry rubber.

PLANTING AND REPLANTING

In planting seed of selected trees, we meet often the difficulty, that we get only a small number of seeds in consequence of the low fertility of the tree. In such a case the method which Ramaer described and which

gives *two seedlings from one seed,* will be useful. When the seed has germinated and the young stem has just emerged from between the cotyledons, the top of the stem is cut away and the base of the stem at a length of about ½ cm. above the insertion of the cotyledons is left. Thereupon the main root, the hypocotyl and the rest of the stem are split lengthwise. After some time the buds, situated in the axils of the cotyledons begin to swell and develop into two new stems, while two halves of the main root develop each into a new main root.

After the operation the plants must be treated with care and planted out into a loose soil. After some time, when a few green leaves have been developed, the cotyledons are exhausted and dry up, and the two plants stand independent from each other. A short period of rest sets in, in which, however, the root develops further; then the final buds develop again. At this time the seedlings must be transplanted. In the beginning these "twin-seedlings" are a little backward in comparison with ordinary ones, but after some time no difference is to be seen.

The question of rejuvenation of the old fields planted with planting material which is at present regarded as being of inferior quality, is still much discussed.

Koch proposed not to interplant between the old trees, but to apply a drastic tapping system during two years and to replant entirely in the third year. He calculates, that, if the old trees are left standing, they would produce in 18 years 3600 kg., rubber per bahu (0·7 ha.), while one would get from one bahu, if it is replanted with superior strains, in 18 years consecutively: 400 kg., 400 kg. 100 kg. (from the old heavily tapped trees), then four years no yield, and the following years: 120 kg., 200 kg., 270 kg., 270 kg., 340 kg., 420 kg., 460 kg., and finally 500 kg. per bahu, or altogether in 18 years 4710 kg.

Drastic tapping of the old trees before removing is also recommended by Vollema. The system he applies consits in tapping daily with two cuts each over half circumference. The yield thus obtained during three years is three times the ordinary yield. After these three years the old trees are removed and the whole field is replanted.

The question of replanting, rejuvenation and supplying of old fields is also a subject of discussion in a paper of Sutton. It is the opinion of the author, that this question must seriously be considered for old rubber fields, even if the production is still some 400 lb. per acre (450 kg. per ha.). Replanting, *i.e.,* removing all the trees and replanting the whole field is, in the opinion of the author, to be preferred if the field taken as a whole is no longer first rate and he considers it advisable to replant every year 1/20 part of the whole plantation, thus the whole plantation being renewed in 20 years. Rejuvenation, *i.e.,* the removal of some 60 or 70 per cent. of the original stand should be applied where there is a good proportion of sound rubber. Supplying, consisting in removing some 30% of the trees, should be applied in the best fields. The whole scheme may be then, that replanting is begun with the worst fields and supplying with the best fields, which will presumably be the last to be replanted in the 20 years of replanting.

In replanting great attention must be paid to the tapping out of the area. A general method of tapping out is difficult to give, the method must have regard to former tapping systems, but as a general rule every day tapping should be instituted as soon as is possible and a five-year basis should be taken. The felling and removal of stumps is a formidable work and, if done by hand a most expensive one. The author recommends using monkey winches and tools of the "Handy Andy" and "Forest Devil" description. Jacks are useless for this type of work. A gang of about five coolies is sufficient for one machine, which can deal with from 15 to 25 trees

per day. Promiscuous burning should on no account be allowed as it impoverishes the soil. In hilly terrain contour terracing is recommended. On lands where the subsoil is heavy or lacking in porosity, the interplanting of *Albizzia* has been found most advantageous in the breaking up of the subsoil.

After the soil has been dug in the ordinary way, the trees can be planted. The great question is: what planting material should be used? if only seedling from selected trees are planted a very close initial stand should be taken, say about 250 to the acre (about 625 per ha.). But the author prefers to plant alternately seedlings and budded trees, with an initial stand of 200 trees to the acre (500 per ha.) and a final stand of 90 to 100 in ten years. As regards rejuvenation, the author gives an example of a field of 24 acres having 78 trees to the acre and yielding 312 lb. per acre. Of these 78 trees those, which give less than 4·8 lb. rubber (per year) are removed. This is the case with 56 trees; 22 with a production of 4·8 lb. or more per year are left. These trees give 138 lb. rubber per year.

The different systems to be followed in terracing or a clearing were discussed by Holland. Holland discussed: (1) whether holing is to be done before or after terracing; (2) the distance apart of the terraces, and the spacing of the plants in the terraces; (3) the width and slope of the terraces. In 11 figures the main types of terraces are represented.

SOIL AND MANURING

De Vries gave a short review of the manuring experiments in Java.

In total 94 experiments were running in 1928, 17 of which with young trees, but only 51 of these came up to the requirements of method. Of these 51 experiments, 9 were running for a too short time to allow an opinion about the results, while with 12 the result was more or less dubious; 21 experiments gave a positive result.

Apart from the experiment at Djasinga Estate, Serpong Estate and Soekamadjoe Estate, in which the manuring (sulphate of ammonia gave an increase in yield of 20%, 35%, and 25% the following successful manuring trials must be mentioned.

Nitrogen-manures gave an increase in yield on the following estates: Soekamadjoe (young volcanic soil) (diammonphos more successful than sulphate of ammonia), Parakan Salak and Tjilentab (both on young volcanic soil), Soemoerbarang and Tjibaroekgak (tertiary soils), Boeniseuri (tertiary volcanic soil) Pondok Gedeh (young volcanic soil). Potassium manure seems to have some effect on the estates Bodjong Godeh (boundary between young volcanic and tertiary soil).

Lime seems to have some effect on the soil of the estate Tjikasintoe.

Nitrogen-phosphor manure gave an increase in growth of nursery plants on the estates Djasinga, Soekamadjoe and Tjikasintoe (boundary between tertiary tuff and marly soils).

Nitrogen-phosphor-potassium manure had effect on nursery plants on estates Serpong and Bolang.

As regards the method of determining the need of manure of the old fields by means of manuring experiments in nurseries, in six cases this method was tried and the results compared with those of direct manuring experiments in the field. In five of these cases the results did not correspond and in one case the correspondence was dubious. The "nurser - manuring-method" thus does not seem recommendable with rubber.

In Ceylon Roy Bertrand carried out a manuring experiment with pots and lawn plots. The object of the experiment was to test the amount of root growth induced in mature rubber by the application of different manures. 11 different manures were tried, both organic and inorganic ones. As the author correctly points out this experiment must only be considered tentative and it is only able to give indications in some directions. The author considers that it appears from this experiment: 1. that inorganic manures produce as much root growth or more than an equal value (monetary) of organic manures; 2. that alkaline or neutral fertilisers appear best suited. to the soils in question; 3. that the effect of organic manures does not appear to last longer than that of inorganic ones.

An account, given in 1928 by Lord, of a statistical examination of the results of the manurial experiments 1914-1924 is revised by this author in which revision the yields of the different plots are figured out with use of the "regression coefficient." This method has recently been used by Eden in examining the effect of lime on tea (see *Tea Quarterly*, 1929, Vol. II, Part I, page 8.)

In order to give an idea of the yields obtained, those of the two first years may be mentioned here:

Yield of dry rubber per tree

Year	Control plot	Manured plot
1914	2·69 ...	2·37
1915	3·62 ...	3·50
1926	5·50 ...	6·06
1927	5·44 ...	7·31

The manurial plot received per acre yearly: groundnut cake 182 lb., steamed bone meal 43 lb., blood meal 100 lb., and sulphate of ammonia 150 lb.

The value of the regression coefficient for the two series of yields for the whole period of the experiment is +0·1085 and the conclusion is that the manured plot has gained on the control plot at the rate of 0·1 lb. per year and that this gain is due to the manurial treatment. This figure of 0·1 lb. shows the cumulative effect of the manure over a period of fourteen years. The mean average increase of the nitrogen over the control plot is 0·5 lb. and it is this figure which should be used in judging the profitableness of the treatment.

THINNING OUT

Whether Ashplant's method of using the diameter of the latex tube as an indication of the yield will indeed prove useful in plantation practice is, according to De Vries, still quite uncertain. Ashplant has not yet given a complete exposition of his method and we are left in ignorance about the way of preparing, colouring and measuring the latex tubes in the leafstalks of the young plants. But, apart from this fact, Ashplant gave figures which show a rather close correlation between the diameter of the latex tube and the production in old trees; we have however no proof, that there is also correlation between the diameter of the latex tube of the *young* seedling in the nursery and the yield of the tapped tree. Another weak point in the method of Ashplant is the fact, that he figured out the average diameter of the latex tube of each plant by measuring 120 latex tubes. For plantation practice such a large number of measurements would be impossible, but then the question arises, how great the error is when a smaller number of measurements are made.

De Vries figures out how great the difficulties would be in applying Ashplant's method, even if we satisfy ourselves with eliminating in the nursery 25% of the plants viz. those with the smallest latex tube diameter, or (other method) in selecting for planting out only the 25% with the largest diameter, making only one measurement (and not 120) for each plant. In the last mentioned case—*i.e.*, planting out the 25% best plants—a gang of 3 to 4 trained laboratory workers would need 10 days for selecting the plants for one hectare, and if 100 are to be planted in 4 months a gang of at least 12 laboratory workers would be busy during that time. These considerations show clearly, that Ashplant's method—even if it would be a reliable one, which is quite uncertain—is unsuitable for plantation practice. De Vries thinks it possible that the method may have some value for the work of testing the different clones.

TAPPING

The fact that the yield of budded trees decreases less rapidly than that of seedlings with the distance from the soil opens a large field of investigation.

De Vries published the result of an experiment, in which 5 budded trees were tapped with two cuts above each other two budded trees with three cuts and one with four. The trees were budded in December 1920 and in June 1919 and planted over in January and February 1921. They were tapped from May to October 1926 over 1/3 three times every week.

The results are given in the following table:

Table VI

Tree No.	Cut	Height of the cut in metres	Sector	Yield per tapping in grammes	Yield of the upper cut in percentage of the yield of the lower cut.
53	lower	½	—	7·0	—
	upper	2½	same	3·95	57
68	lower	½	—	11·5	—
	upper	3¾	same	5·4	47
76	lower	½	—	6·4	—
	middle	2½	same	3·2	50
	upper	3¼	same	4·4	69
78	lower	½	—	8·6	—
	upper	2½	other	6·1	71
79	lower	½	—	6·1	—
	middle	2½	same	2·6	43
	upper	3¾	same	4·05	67
80	lower	½	—	6·15	—
	middle 1	2½	other	2·9	47
	middle 2	3½	same	2·65	43
	upper	3½	other	2·8	46
81	lower	½	—	7·0	—
	upper	3	other	5·0	71

In this case the average yield of the lower cut was 7·55 gm. The yield of the upper cut was 43 to 71% of that of the lower cut, and on an average 61%. No essential difference could be seen between the upper cuts at different heights or between the upper cuts in the same sector and those in another sector. As a preliminary conclusion it can be stated that an upper cut of a budded tree at a height of 2½ to 3 m. produces still about 60% of the yield of the lower cut.

Vrolyk published results of a similar experiment. Four plots were used in this experiment, viz. R1, W1, R2, and W2; they consisted of 13, 10, 10 and, 12 budded trees. The trees were tapped on 1/3 every other day from Nov. 1927 to May 1928. The average yield of dry rubber per tapping was in that time as follows:

R 1: 13·1 gm.
W 2: 14·97 gm.
R 2: 22·03 gm.
W 1: 15·45 gm.

On 1st June 1928 the plots R 1 and W2 were used for a two-cut tapping, while R 2 and W 1 were used as control and tapped as before with one cut. At the beginning of the experiment the lower cut on the trees of the plots R 1 and W 2 was situated at a height of 30 to 50 cm. above the soil; the upper cut was applied at a distance of 1·5 m. above the lower cut.

A comparison of the yield obtained on the four plots, before and after the two-cut system was applied in plot R 1 and W 2, is given in the following table:

Table VII

	Yield per tapping in grams of dry rubber					
	Control plots			Experimental plots		
	W 1	R 2	Average	R 1	W 2	Average
Preliminary tapping (one cut in the four plots) ...	15·45	22·03	18·74	13·1	14·97	14·035
Experimental tapping (one cut in the control plots and two cuts in the experimental plots) ...	16·13	24·28	20·20	23·70	26·13	24·9
Yield of the experimental tapping expressed in percentages of the yield of the preliminary tapping	104%	110%	108%	181%	174%	177%

The surplus of yield of the experimental tapping above the preliminay tapping is therefore 69% heigher in the experimental plots than in the control plots.

While in the experiment described by Vrolyk the upper cut was located in the same sector as the lower cut, Heusser and Holder applied on budded trees a system in which the two cuts are placed on two adjacent tapping areas, each of which occupies one quarter of the circumference, the vertical distance of the two cuts is 1 m. The left hand cut (panel 2) was started at two metres, the right hand cut (panel 1) at 1 metre above the union of stock and scion (quite near the surface of the soil). When (panel 1) will be tapped up to the union of stock and scion (near the soil), the panel 3 will be opened at a height of two metres, and when panel 2 will be finished, panel 4 will be opened at a height of two metres.

With this system with alternate monthly tapping and with a bark consumption of 45 mm. ($1\frac{3}{4}$) per month (27 cm. per year) a bark renewal period of $14\frac{1}{2}$ years is provided for.

This new system was applied to 300 five-year-old budgrafts, 100 of each of the clones 51, 80 and 65. For control budgrafts and seedlings were tapped with one cut over $\frac{1}{3}$.

Putting the yield of the seedlings at 100 the following figures were obtained of the yield of the budgrafts :

Table VIII

	Old system ($\frac{1}{3}$ cut)	New system ($\frac{1}{4}$ double cut)
Clone 51	142	192
Clone 80	170	206
Clone 65	183	277

If we put the yield of the budgrafts tapped at $\frac{1}{3}$ at 100, the following figures are obtained :

Table IX

	Old system ($\frac{1}{3}$ cut)	New system ($\frac{1}{4}$ double cut)	Upper cut	Lower cut
		Total		
Clone 51 ...	100	135	65	70
Clone 80 ...	100	121	58	63
Clone 65 ...	100	151	71	81

From these figures it is apparent, that the new tapping system has given very promising results. Clone 65—an average clone—produced with this system 870 kg. per hectare of 200 trees, a yield which has never been obtained with the ordinary tapping system of any clone in its sixth year.

Another new tapping system was described by J. Bosch. It consists in dividing the cut into two (or more) cuts, separated from each other by a small piece of bark. The length of each cut being shorter the system allows a less steep slope of the cut, which results in more latex per cm. The inventor claims that in tapping with this system, in which a narrow stripe of bark is left untapped between the two or more parts of tapped bark, the sap-flow of the tree is furthered, and he assumes that this will have a beneficial effect on the bark renewal. This system has apparently not yet been tested.

It has been suggested, that bast, treated for brown bast disease by the scraping method as advised in *Rubber Research Scheme Bull.* No. 48, would be after renewal more readily affected by this disease.

Mitchell is of opinion that this is not the case and gives a photograph of a tree which has been tapped for over two years on the third day system and is now continuing to give satisfactory yields, without any indication of brown bast development.

In this connection it may be remembered, that in Java and Sumatra the treatment of brown bast by removing the diseased part of the bark is no longer done, since it has been proved that the diseased tree recovers well, if only the cut is made shorter. After the tree has been tapped with a cut of $\frac{1}{4}$ to $\frac{1}{6}$ either every-other-day or with a periodical tapping system (for instance every-other-month) the tree recovers within a short time.

The question as to what period of tapping is the most profitable was the subject of an elaborate study of Schweizer. It was Hoedt, who pointed out a few years ago (*Archief voor de Rubbercultuur in Nederlandsch-Indie*, Vol. 10 (1926) P. 566), that in using systems of periodical tapping the yearly yield is different with different periods used; it may make a great difference whether the tree is tapped every other week or every other month.

This is the consequence of the so-called "wound response" *i.e.*, the fact, that after a period of rest a tree does not give immediately its highest yield, but only reaches its maximum daily yield after a certain number of tappings. After having reached this maximum we see a decrease set in. It is obvious that it is not economical to choose the tapping period so short that tapping is stopped before the maximum yield is obtained, nor continuing tapping so long, that the decrease in production has passed a certain limit. It is thus the course of the increase-decrease of yield which determines what length of tapping period is the most economical.

Schweizer shows, that the increase-decrease curve depends on the intensity with which the tree recovers its production. In fields with a high yield the trees reach a higher maximum after rest and take a longer time to reach this maximum; in fields with a lower latex-production the trees—speaking generally— reach a maximum which is lower and which is obtained in a shorter time (after a smaller number of daily tappings). As a general rule it may be said that under conditions which allow a high yield the increase in production lasts longer, and a higher maximum is obtained, than under conditions which do not allow of such a high yield.

It is well known that the yield of the trees, when tapped every day, or every other day, is not the same in different months: some three months after wintering—*i.e.*, generally in the month of October in Java—the tree gives the highest yield, then a decrease of yield takes place till about January, again an increase takes place and a second top of the yield-curve is reached in June; in July the yield decreases again and in August the yield is at its lowest. Accordingly, when the tree is tapped every other month, the increase-decrease curves are different in the different months: in the months of high yield the top of the increase-decrease curve is attained after a longer time than in the month of lower yield. This may be illustrated with the following figures:

A field, which gave its highest yield in October, followed by a decrease till February, followed by an increase till June, followed by a decrease till. August, followed by an increase till October, was tapped every other month. The number of days the trees were tapped till the maximum production was reached was as follows:

	April	June	August	October	December
Maximum yield reached after:	13	16	9	21	10 days

In this case—which was published by Hoedt—it was not economical to tap every other month, because the last part of the month (sometimes, August, even the last 22 days) the yield decreased again, and it would have been better to stop tapping at an earlier date, *i.e.*, to make the tapping periods shorter. An experiment with tapping every other fortnight confirmed this supposition; indeed 19% more rubber was obtained than with the every-other-month tapping system.

The general rule is therefore: in fields with a low production a higher yield is obtained when short tapping-periods are used, in fields with a large yield a higher yield is obtained with longer tapping-periods. In theory the ideal would be to fix the most profitable length of period for each field, but this is practically impossible. We may be satisfied when each planter determines what is the most profitable average period for his fields; in some cases it will be advantageous to make a difference for two parts of the estate, if there is a marked difference in yield between one part and the rest of the plantation.

MANURIAL EXPERIMENTS ON HEVEA

THE present paper gives the continued results over the last three years of the "Second Nitrate Manuring Experiment," the previous results of which were communicated in former papers (1), (2), and in addition the results of a new experiment on red liparite tuff soil.

SECOND NITRATE MANURING EXPERIMENT

The complete yield data of this experiment for the years 1927-1928, 1928-1929 and 1929-30 are given in table 1. The results given each year are discussed below. The tapping system of the experiment remains the same as previously, namely, daily tapping on half of the circumference in alternate months using 2 in. of bark per tapping month.

Ninth year, March 1927-February 1928.—The C. plots received the usual annual application of 5 lb. (2·27) kg.) sodium nitrate per tree in February 1927 and gave a yield of 672 lb. per acre (753 kg per ha) for the year,which was considerably in excess of any previously obtained, and the highest yield reached up to that time.

The B plots received 4 lb. (1·81 kg.) of ammonium sulphate per tree in February 1927, this now being a standard annual application for these plots beginning from 1926. The yield for the year was 426 lb. per acre (478 kg. per ha), the highest yet secured from this series.

The E plots, being manured in alternate years with 4 lb. (1·81 kg.) ammonium sulphate, received no manure in 1927 and gave a yield of 574 lb. per acre (664 kg. per ha), again the highest yet secured.

The D plots received 2 lb. (0·9 kg.) ammonium sulphate per tree in February 1927, this now being the standard application for these plots once in two years, commencing with 1925. The yield for the year was 472 lb. per acre (529 kg. per ha), also the highest to date.

All manured plots continued to show progress in general appearance and this improvement was perhaps most marked in the B series, now on an annual manuring basis after several years of no manuring.

The control plots (A series) continued to exhibit the same deteriorated appearance. The yield, however, showed some improvement being 307 lb. per acre (344 kg. per ha), the highest recorded since 1920-21.

Tenth year, March 1928-February 1929.—The C plots received the usual annual application of 5 lb. (2·27 kg.) sodium nitrate per tree in February, 1928 and reached the astonishing yield of 764 lb. per acre (858 kg. per ha) for the year. A stage has been reached in these plots at which further improvement in appearance is not noticeable. The continued increase in yield, far beyond that which was originally anticipated, is remarkable.

The B plots received the usual annual application of 4 lb. (1·81 kg.) ammonium sulphate per tree in February 1928, and gave a yield of 531 lb. per acre (595 kg. per ha) for the year, a new high record for the series.

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* By J. Grantham in *Archief voor de Rubbercultuur*, No. 9, Sept., 1930.

(1) Manurial Experiments on Hevea, *Archief voor de Rubbercultuur* VIII, No. 8, August, 1924. (Summary published in *The Tropical Agriculturist*, Vol. LXIII, No. 5, p. 259.).

(2) Manurial Experiments on Hevea II, *Archief voor de Rubbercultuur* XI, No. 10, October, 1927. (Reproduced in *The Tropical Agriculturist*, Vol. LXXVI, No. 1, January, 1931.)

The E plots received the biennial application of 4 lb. (1·81 kg) ammonium sulphate per tree, which has continued since 1920, and reached a yield of 671 lb. per acre (752 kg. per ha) for the year, the highest yet secured from any series except series C for this year.

The D plots were not manured in 1928, but showed a further increase in yield to 530 lb. per acre (594 kg. per ha).

The control A plots gave a yield for the year of 361 lb. per acre, (405 kg. per ha) the highest so far secured. The reason for the increased yield in these plots is not quite clear, since the appearance of the plots was very poor. The increase is, however, smaller than in any of the other plots.

Eleventh year, March 1929-February 1930.—The C plots received the usual annual application of 5 lb. (2·27 kg.) sodium nitrate per tree in February. The yield for the year amounted to 757 lb. per acre (849 kg. per ha) just below that for the previous year.

The B plots received the usual annual application of 4 lb. (1·81 kg.) ammonium sulphate per tree in February 1929 and yielded for the year 546 lb. per acre (612 kg. per ha), an increase of 15 lb. per acre (17 kg. per ha) over the previous year.

The E plots were not manured in 1929 and yielded 656 lb. per acre (735 kg. per ha), just below the yield of the previous year.

The D plots received the biennial application of 2 lb. (0·9 kg.) ammonium sulphate per tree and yielded 525 lb. per acre (588 kg. per ha) for the year, again just below the yield of the previous year.

Many trees in the control A plots showed continued severe deterioration, main trunks and branches dying back. Other trees seem to have become stabilized and are not deteriorating. The yield amounted to 358 lb. per acre (401 kg. per ha) for the year or about the same as the previous year.

GENERAL REMARKS

The period under review has shown an increase in yields from all plots. In particular the C and E plots, which have received the longest regular manuring, have reached levels, which were previously quite unanticipated.

The B plots, now on regular annual manuring, after a period of 6 years (1919-24) during which no manuring was carried out, have shown the greatest rate of increase. Although manured annually with 4 lb. (1·81 kg.) per tree of ammonium sulphate since 1926, they are, however, still very much behind the E plots which have been manured once in two years since 1920 with 4 lb. (1·81 kg.) ammonium sulphate per tree. It seems probable that the deterioration, which took place in these plots during the years of no manuring, was sufficiently severe to prevent a rapid recovery in yield on the resumption of manuring. In appearance these plots are now almost equal to the plots annually manured with sodium nitrate and the yield is rising at a more rapid rate.

The D plots, manured with only half the normal quantity per tree in alternate years, showed the lowest yield of the manured plots. As with the B plots, however, these plots have not yet been on the present system of manuring for a sufficiently long period to render direct comparison with the older manured plots justifiable.

The rise in yield per acre of the control plots is an unexpected feature in the results and it is difficult to know to what this is to be attributed. The roots of the control plots, along the sides of the boundary ditches were cut previous to the manuring of 1930, in order to prevent them spreading underneath the ditches. During this work it was found that such spread of the roots occurred but seldom. A mass of feeding roots from the control plots was, however, found along the bottom of the ditches. Possibly a certain amount of manure has been washed from the manured plots to the ditches in

and adjoining the control plots, and absorbed by these feeding roots. In appearance the condition of the control plots is deplorable. It seems certain that an appreciable percentage of the trees will die in the next few years and, while other trees appear to have become stabilized, their general condition and bark renewal is very poor.

It will be seen that the yields of the 11th year, with the exception of that of series B, which shows an increase of 15 lb. are all a few pounds per acre below the yields for the 10th year. The actual difference in yield is inappreciable, but the steady increase, which has been characteristic of the last few years, did not take place. Whether this indicates that we are reaching a stage at which the maximum results have been secured, or whether the halt is merely a temporary one, cannot yet be decided. Up to the middle of 1929 it seemed probable that the previous year's yields would be exceeded. The somewhat disappointing yields of the latter half of the year were characteristic of yields in general and it is probable that the abnormally dry weather in the middle of the year had a prejudicial effect on subsequent yield. It must, therefore, be left to the future to determine whether the maximum yield has yet been reached by manuring.

NEW EXPERIMENTS ON RED SOIL

In the original paper, an experiment showing the effect of various artificial manures, including sodium nitrate, on six-year-old trees on red liparite tuff soil on Goerach Batoe was described. This experiment ran for 16 months, but, contrary to the results obtained on the white soil, no significant effect was produced on either yield or appearance. The yield and growth of the trees without manure were quite satisfactory. In more recent years, however, it has been observed that, after the trees on the red soil reach an age of from 12-15 years, deterioration gradually sets in. The foliage becomes perceptibly thinner and yellower and the leaves smaller. Bark renewal becomes less satisfactory and the yield falls off. These features are not unlike those previously observed on the white soil, but occur more gradually and before deterioration starts, the trees are much larger and more vigorous and give a higher yield per acre.

As an example of the falling off in yield, which is occurring on the unmanured red soil, the following yields from an experimental area of ± 200 acres may be cited:

Age (Years)	Lb. per acre	Kg. per ha
8	525	588
9	610	684
10	618	693
11	635	712
12	535	600
13	525	588
14	454	509

Nitrogen Manuring Experiment, Goerach Batoe.—As a result of the above observations an experiment was laid out in February 1926 in 15-year-old rubber where this deterioration* was already evident, on a red liparite tuff soil, on Goerach Batoe. The experiment consists of four series of plots which receive the following treatment:

* No separate yields for the precise area occupied by the experiment for the years preceding the experiment are available, but deterioration in appearance was quite plain The block had previously the reputation of being a high-yielding area and it is almost certain that the experimental area previously exceeded 600 lb. per acre or 673 kg. per ha. at the time of its maximum yield. It will be seen from table 2 that during the first-three years of the experiment, the control plots show a rising yield, the fourth year being very little less than the third. No clear explanation can be advanced for this increase in yield, but the highest yield that of 1929, is certainly below the maximum obtained in the best days of the area.

Series A Control

,, B manured with 4 lb. (1·81 kg.) ammonium sulphate per tree annually.

,, C manured with 5 lb. (2·27 kg.) sodium nitrate per tree annually.

,, D manured with 5 lb. (2·27 kg.) sodium nitrate in alternate years.

Each series consists of eight individual plots of equal size, isolated by ditches, containing an average of +60 trees each, with a total area for each series of 6·6 acres (2·67 ha). The individual plots are arranged in usual chess-board fashion and the tapping tasks planned so that each tapper taps an equal area of each series. The tapping system is the normal estate system of one half cut alternate month, using 2 in. of bark per tapping month. All plots are clean weeded, except for the soil conservation bunds and the berms along the ditches, which are covered with vigna.

The first application of manures was made in March 1926. The yield results to date are shown in table II.

In the first year, although some slight improvement was noticed in appearance, the effect of the manuring on yield was nil. After the second manuring of series B and C in February 1927, the improved appearance of the foliage in these plots was definite and the yields of the manured series, during the second year of the experiment, showed improvement. The difference was, however, only just sufficient to be significant (percentage increase required in order to be significant 6%). Following the third manuring of series B and C and the second manuring of series D in March, 1928, the improvement in appearance became more pronounced and, during the third year of the experiment, definitely improved yields were obtained, which continued for the fourth year of the experiment. The best series is now series B, which gave a yield of 18% more than the control in the fourth year. The percentage increases are, as yet, comparatively small in comparison with those obtained on the white soil and comparisons of the yields of the manured series between themselves are subject to a probable error, which renders the differences of no significance. All manured plots are, however, giving definite increase over the control and although, with a low rubber price, the certain increase in yield little more than pays for the cost of manuring, the yields may be expected to increase in subsequent years and the manuring results in a much healthier condition of the trees. It will be noted, however, that the yields of the control plots are at a much higher level than those on the white soil.

Other and more recent experiments are in progress on the red soil, the results of which it is hoped to publish at a later date. These experiments, on combined nitrogen and phosphate manuring, were initiated in 1928 as a result of favourable results on growth, obtained with nitrogenous and phosphatic manures in nurseries on the same soil type. It may be said, at present, that these experiments confirm that on Goerach Batoe recorded above, in so far that a beneficial effect on yield is being obtained from the application of nitrogen, but in no case can any additional effect yet be attributed to the phosphatic part of the manure.

Table I

Yields in lb. per series of plots, total area each series 6 acres, 1st latex and lump only. Lower figures show percentage relationships to control series A.

Series	Treatment in 1927	1927 March 17th-April 15th	1927 May 17th-June 15th	1927 July 17th-August 15th	1927 Sept. 17th-October 15th	1927 November 17th-December 15th	1928 January 17th-February 15th	Total March 1927-Feb. 1928	Lb. per acre per year	Kg. per H.A. per year
A	Control	172 100	276 100	345 100	319 100	353 100	376 100	1841 100	307	344
B	4 lb. ammonium sulphate per tree—February	262 152	376 136	448 130	438 137	513 145	518 138	2555 139	426	478
C	5 lb sodium nitrate per tree—February	506 294	616 223	712 206	648 203	751 212	799 213	4032 219	672	753
D	2 lb. ammonium sulphate per tree—February	284 165	465 168	520 151	475 149	559 158	530 141	2833 154	472	529
E	None	364 212	560 203	622 180	588 184	675 191	638 170	3447 187	574	644

Series	Treatment in 1928	1928 March 17th-April 15th	1928 May 17th-June 15th	1928 July 17th-August 15th	1928 Sept. 17th-October 15th	1928 November 17th-December 15th	1929 January 17th-February 15th	Total March 1928-Feb. 1929	Lb. per acre per year	Kg. per H.A. per year
A	Control	220 100	328 100	414 100	397 100	409 100	401 100	2169 100	361	405
B	4 lb. ammonium sulphate per tree—February	351 160	489 149	602 145	547 138	584 143	614 153	3187 147	531	595
C	5 lb. sodium nitrate per tree—February	572 260	717 218	864 209	786 198	782 191	863 215	4584 211	764	858
D	None	354 161	489 149	622 150	549 138	572 140	595 148	3181 147	530	594
E	4 lb. ammonium sulphate per tree—February	481 219	639 194	745 180	697 175	719 176	746 186	4027 186	671	752

Series	Treatment in 1929	1929 March 17th-April 15th	1929 May 17th-June 15th	1929 July 17th-August 15th-	1929 Sept. 17th-October 15th	1929 November 17th-December 15th	1930 January 17th-February 15th	Total March 1929-Feb. 1930	Lb. per acre per year	Kg. per H.A. per year
A	Control	307 100	354 100	430 100	357 100	357 100	343 100	2148 100	358	401
B	4 lb. ammonium sulphate per tree—February	469 152	512 145	620 144	517 145	547 153	610 178	3275 155	546	612
C	5 lb. sodium nitrate per tree—February	738 240	713 201	856 199	689 193	739 207	804 234	4539 211	757	849
D	2 lb. ammonium suphate per tree—February	471 153	512 145	605 141	501 140	523 147	541 158	3153 147	525	588
E	None	609 198	636 180	743 173	621 174	657 184	672 196	3938 183	656	735

TABLE II

Yields in lb. per acre 1st latex plus lump only—Manuring Experiment on Red Soil—G. Batoe. Lower figures show % relationships to control.

Series	Treatment in March 1926	1926 March	1926 May	1926 July	1926 September	1926 November	1927 January	Year 1926-1927 Lb. per acre	Year 1926-1927 Kg. per H.A.
A	Control	61·3 100	64·1 100	81·1 100	67·2 100	66·8 100	73·4 100	414 100	464
B	4 lb. ammonium sulphate per tree	59·8 98	65·4 102	79·5 98	67·0 100	67·1 100	73·5 100	412 100	462
C	5 lb. sodium nitrate per tree	58·0 95	63·5 99	77·8 96	69·0 103	67·7 101	73·4 100	409 99	458
D	5 lb. sodium nitrate per tree	64·3 105	67·9 106	82·9 102	66·7 99	70·7 106	73·7 100	426 103	478

Series	Treatment in February 1927	1927 March	1927 May	1927 July	1927 September	1927 November	1928 January	Year 1927-1928 Lb. per acre	Year 1927-1928 Kg. per H.A.
A	Control	66·7 100	76·8 100	81·8 100	79·9 100	83·7 100	79·6 100	468 100	525
B	4 lb. ammonium sulphate per tree	71·5 107	80·6 105	84·3 103	86·3 108	91·6 109	88·7 111	503 107	564
C	5 lb. sodium nitrate per tree	70·0 105	82·2 107	87·0 106	85·9 107	91·7 109	90·4 113	507 108	568
D	None	69·5 104	80·1 104	84·6 103	88·9 111	94·4 113	91·7 115	509 109	571

Series	Treatment in February 1928	1928 March	1928 May	1928 July	1928 September	1928 November	1929 January	Year 1928-1929 Lb. per acre	Year 1928-1929 Kg. per H.A.
A	Control	57·3 100	65·5 100	91·9 100	104·7 100	96·6 100	106·7 100	523 100	586
B	4 lb. ammonium sulphate per tree	62·8 109	77·8 119	110·3 120	114·2 109	108·9 113	123·8 116	598 114	670
C	5 lb. sodium nitrate per tree	66·5 116	79·4 121	109·5 119	108·3 103	111·9 116	122·8 115	598 114	670
D	5 lb. sodium nitrate per tree	68·6 120	82·0 125	110·7 120	114·1 109	108·8 113	121·3 114	605 116	678

Series	Treatment in March 1929	1929 March	1929 May	1929 July	1929 September	1929 November	1930 January	Year 1929-1930 Lb. per acre	Year 1929-1930 Kg. per H.A.
A	Control	77·0 100	83·3 100	96·5 100	89·9 100	82·4 100	80·0 100	509 100	571
	4 lb. ammonium sulphate per tree	84·0 109	100·6 121	111·8 116	107·1 119	99·1 120	98·6 123	601 118	674
C	5 lb. sodium nitrate per tree	81·0 105	96·9 116	111·2 115	103·3 115	92·6 112	96·1 120	581 114	651
D	None	77·6 101	92·0 110	108·4 112	107·6 120	97·1 118	91·8 115	574 113	643

FLUE-CURING OF TOBACCO*

Curing.—Correct curing is one of the most important steps in the production of flue-cured tobacco. The fact, however, must not be overlooked that unless fundamental principles, such as the right soil type, fertilisation, and variety, are given due consideration in the growing of flue-cured tobacco, no satisfactory cure can be expected. On the other hand, good quality flue-cured tobacco on the land may be completely ruined through negligence or carelessness in the operation of curing. The importance of curing cannot, therefore, be over-emphasized.

In the curing of flue-cured tobacco, however, no hard-and-fast rule can be offered. General principles can be laid down, but no formula as to temperatures and humidity can be given. The rate-of-curing temperatures and humidity to follow, naturally depend on the ripeness of the leaf, thickness and body, soil effect, climatic conditions, position of leaf on the plant, variety, and a number of other factors. Any formula given must, therefore, only serve as a guide, and must under no circumstances be accepted as correct for the curing of all flue-cured tobacco. Curing can best be learned only through practical experience.

Harvesting.—The correct harvesting of flue-cured tobacco has an important bearing on the success of the resultant cure. For the uniform curing of good quality tobacco, a first requisite is that the barn be filled the same day with leaves of uniform ripeness and character. The leaf must be fully ripe, but not over-ripe, as this causes it to be too brittle. Green leaves must not, under any circumstances, be picked, as they will cure green, black, or mottled, and are practically valueless. The importance of picking uniform, ripe leaves of the same character when filling the barn cannot, therefore, be over-stressed. If the leaves are not of the same ripeness and character, the yellowing and rate of curing in the barn will be uneven, with the result that some leaves will be yellow and ready for fixing, while others will still be green. The result is obvious: some will cure green.

Unlike air-cured tobacco, the leaves are primed off or picked as they ripen, from the bottom of the plant upwards. Generally, about four leaves per plant are picked at a time, depending, however, on the ripeness of the crop. From three to five pickings are necessary to complete the harvesting. To conform with this requirement, it is necessary to prime every week or every fortnight. If the crop is uneven or the ripening developed too far, it means that sand leaves, leaves from the middle of the plant and sometimes even tips, are cured in the same barn at the same time. This difference in the character of the leaf will result in a poor cure and subsequent loss. The necessity of growing a uniform crop of tobacco will therefore, be realised.

After picking, the leaves are placed on suitable receptacles which may be baskets or a box-like arrangement made from hessian sewn to a wooden frame. Both give satisfactory results. The basket consists of a wooden frame to which four grain bags, sewn together longitudinally are fixed. These containers are taken to the land, and the leaves are carefully placed in them. Great care must be exercised in handling the leaf, and in placing it in these receptacles, to avoid injury or its becoming sunburnt by too long exposure to the sun. Leaf damaged in this respect is practically ruined.

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* By W. R. Thompson, B.Sc. Agri. in *Bulletin* No. 88 of the Department of Agriculture of the Union of South Africa.

When sufficient receptacles have been filled to fill a barn, they are carried to the stringing shed, or the picking and tying are carried on simultaneously in the lands. Except when weather conditions are unfavourable, the latter method is to be preferred. In this case, stringing is generally done in the shade of a tree if one happens to be near the land, or under a bucksail supported by poles. If this method is followed, it is best to have three or more baskets, so that while the one is being emptied, one is filled and the third is on its way to the stringing place.

In the United States of America, small trucks (sleighs) 2 feet by 6 feet by 4 feet high, hauled in between the tobacco rows by a mule while being filled, are commonly used for bringing the tobacco from the land to the drying place. Although this last method is the most efficient, any of the above, or any other method may be used in transporting the leaf, as long as it is not damaged, bruised, or allowed to become sunburnt. However, it must always be considered that the best method to employ is the one requiring the least labour.

Tying.—After the leaves have been brought to the stringing place, they are tied to a stick by means of ordinary thin twine. A string is tied to one end of a stick 4 feet 6 inches long (conforming to the tier poles in the barn) by 1 inch in diameter, and the leaves are tied to the stick in bunches of three to four, according to the size of leaf. The manner of tying these bunches (24 to 30 bunches per stick) is by means of a special twist or loop around each bunch in such a way that they hang alternately on each side of the stick. When the stick is fully loaded the free end of the string is tied to the other end of the stick. It is now ready to be hung in the barn for curing. In tying, some hand on the leaf in bunches of three or four to those tying. Generally from one to three labourers are required to hand on to each one tying. With practice, the process becomes easy and quick to perform. Three tying may easily fill a barn a day.

To allow for proper ventilation, it is best not to crowd the tobacco on the sticks, or the sticks in the barn. A standard barn 16 feet by 20 feet takes approximately 500 sticks and cures from 400 to 600 lb., depending on the tobacco.

Filling the Barn.—When the required number of sticks has been strung, the barn should be filled immediately and the tobacco not left in the stack for any length of time, as it may heat up and become damaged. The actual filling of the barn is easy. However, there are certain facts not to be overlooked. In the first place, it is desirable to fill the barn in one day or else the curing will not be uniform. Furthermore, when filling, crowding of the sticks is to be avoided, about 8 inches being allowed between them on the tiers, depending largely on the size and character of the tobacco. This is necessary for proper ventilation. Again great care must be exercised, in filling not to bruise or injure the leaf, as such leaf will not cure satisfactorily.

Barns.—To flue-cure tobacco successfully, it is essential to have an air-tight barn with the necessary controlable top and bottom ventilators. The principle involved in the flue-curing of tobacco is to have complete and perfect control over the moisture condition and the temperature of the barn. It will readily be appreciated that if the barn is not airtight, with the necessary ventilation which may be increased or decreased as required, this purpose is defeated. In the United States of America, flue-barns are built of wood. In South Africa, where timber is expensive, they are built of brick. Walls constructed of burnt brick to a thickness of 14 inches, ensure a permanent structure.

There are two standard sizes of barn in use, viz: 16 feet by 16 feet by 20 feet high and 12 feet by 12 feet by 20 feet high. Both barns cure equally well. Where labour is a limiting factor in the filling of a barn, the one of 12 feet by 12 feet by 20 feet may be preferred, but when it is considered that the 16 feet by 16 feet by 20 feet barn does not cost correspondingly more, is probably more economical in fuel consumption, holds much more tobacco, and requires the same labour and trouble to cure, the 16 feet by 16 feet by 20 feet barn is to be preferred. The size of barn to be built, therefore, is to be decided in accordance with the circumstances and requirements of the farmer.

Furnaces.—Two types of furnace in use are the home-made brick furnace, and the patent furnace which may be used either for wood or coal. Both are satisfactory. The home-made, or ordinary brick-built furnace, owing to its cheapness of construction, is the one commonly used.

The furnace may be constructed inside or outside of the barn. Both have their advantages and disadvantages. The inside furnace dries the tobaccco immediately above it a little faster while the outside furnace loses too much heat through radiation. Taking everything into consideration, however, the inside furnace is to be recommended as all the heat radiating from it is not wasted, but assists in drying the tobacco, thereby accomplishing a great saving in fuel.

The latest idea is to build the furnace rather long, low, and inside, with only a small part (approximately 1 foot) projecting. The other furnace is higher, shorter, and on the outside. In constructing the inside furnace in this way, little or no damage is done to the tobacco above it, while all the heat radiating from it is efficaciously used. Suitable dimensions (inside measurements) are 6 feet long by 18 inches wide by 12 inches to 18 inches high. Fire bricks or ordinary burnt bricks may be used. A fire grate is necessary, with fire bars preferably lengthwise. Anything that will not bend and which can stand a high temperature may be used. The ashpit is generally about 9 inches to 1 foot below the fire-box, which serves to collect all the ashes and reduced fuel consumption. A door for the furnace is highly essential, and in building the furnace it is best to use ordinary clay, as cement tends to crack as soon as it is subjected to a high temperature.

Whether one or two furnaces are to be used per barn depends on its size and whether it is inside or outside. In a 12 feet by 12 feet by 20 feet barn, one furnace in the centre is ample. In a 16 feet by 16 feet by 20 feet barn, one or two may be advantageously used. Two probably give a better distribution of heat, but are probably not as economical in fuel as where one is used.

Flues.—Circular flues of 10 inches to 12 inches in diameter are mostly used, so that the flue may be arranged inside the barn. The flue systems mostly used in conjunction with single and double furnaces are illustrated in the blue prints. There are several home-made flues which may be constructed cheaply and with good results. Whatever system is used, it should be arranged in such a way that the heat is evenly disrtibuted in the barn. The flues are elevated and inclined upwards throughout their lengths, to obtain the correct draught. They generally pass out through the barn wall into the chimney at a point 1 foot to 1½ foot higher than the mouth of the furnace. It is most important to have the correct draught. The chimney may be built of brick, or flues may also be used for this purpose. To ensure a good draught, it must project above the roof.

Ventilation.—In order to have complete control over the temperature and humidity of the barn, an efficient system of ventilation is necessary. The ventilation system consists of top and bottom ventilators which may be

completely controlled, that is, opened or closed as required. The greenhouse or ridge type of the top ventilator along the entire length of the barn is best. Four bottom ventilators are sufficient, and if they enter the barn below the flue no cold air suddenly enters the barn. Without proper ventilation no success in curing can be obtained.

The Curing Process.—Immediately after the barn has been filled, small fires are started in the furnace, either wood or coal being used, depending on what is the most economical under the circumstances. About one to one and a half cords wood (4 feet by 4 feet by 8 feet), or approximately 10 bags of coal are required to cure a standard barn under satisfactory conditions.

The flue-curing process involves three important stages, viz:

(1) The yellowing of the leaf.
(2) Fixing the colour.
(3) Drying the leaf.

In South Africa, with a comparatively dry climate, yellowing of the leaf without a limited application of artificial moisture in the barn is sometimes difficult, except where yellow, light-coloured, and thin bodied tobacco is cured, such as, for example, Amorelo, or where tobacco grown on very poor soil is cured. For the yellowing of good-bodied tobacco, a limited degree of moisture is necessary in the early stages, depending upon climatic conditions and certain other factors. There are various ways by which this required moisture may be applied, such as, for example, by steam, wetting the floor, or by suspending wet bags above the flues on a 3-foot wire netting. The last method is the most practical, gives satisfactory results, and is to be preferred. The wire netting above the flues also catches any dry leaves which might fall off on to the hot flues, and so reduces the risk of fire. Moreover, if wet sand is used, or if the walls and floor are moistened, it is impossible to get rid of the moisture quickly enough when so desired, with the result that the leaf sponges, that is, the moisture condenses on the surface of the leaf, causing it to burn black or a grey, dirty colour, which is undesirable and considerably reduces it value. This is commonly known as sponging. Wet bags can be easily removed, and the barn thus freed quickly of the excess of moisture, when so desired.

After the barn has been filled, all ventilators are closed, the necessary moisture is put in, if required, and a thermometer (preferably a wet and dry bulb, so that both temperature and humidity of the barn can be read), hung level with the tobacco of the bottom tier and in the centre of the barn.

A small fire is now started in the furnace, and the yellowing of the leaf commences. There should be sufficient moisture in the earlier stages of yellowing to prevent the leaf from drying, and the best means of accomplishing this is by means of an airtight barn.

The temperature should be raised to 80°F., and kept between 80° and 100°F. until the leaf is practically yellow. The temperature should be raised very slowly from 80°F. to 100°F., possibly 5° every ten or twelve hours, to allow the leaf time to yellow. When the tobacco yellows rapidly, the temperature may be raised faster. On the other hand, if yellowing is slow, more time is required. Judgment by the curer is necessary to decide this question. Under average conditions, the yellowing will take from 36 to 54 hours, and sometimes even longer. However, the yellowing period will depend largely on the variety of tobacco, thickness of body, ripeness, soil type, and climatic conditions.

When artificial moisture is supplied by use of wet bags, it must be removed some time before the yellowing is completed, that is, somewhere around 95° to 100°F. The difference between the wet and dry bulb thermometers should now be approximately 8°F., while it should register a difference of from approximately 3°F. in the beginning and a higher difference as the yellowing proceeds.

When the yellowing is pronounced, the temperature is gradually raised to 105° and 110°F. At this stage, the leaf should still have a slight greenish tinge, as the yellowing continues to some extent until around 120°F.

The next step is fixing the colour, and is the most critical period in the process. The moisture is removed, gradually at first, by opening the top ventilators, and a little later also the bottom ventilators, increasing the ventilation slowly until all the ventilators, (both top and bottom) are fully open. Care must be taken to avoid drying the leaf too rapidly, but as it begins to yellow, the humidity in the barn must be diminished by slowly raising the temperature and gradually increasing the ventilation; that is, the moisture is removed as it escapes from the leaf. Never allow the temperature to drop, as this will retard the drying and spoil the leaf. The temperature is now slightly raised to 120° and 125°F. At this stage, the tips of the leaves will begin to dry and curl upwards. Later, the temperature is further gradually advanced to 130° and 135°F. and kept there until the leaf web and small veins are dry. It should not exceed 140°F. before the web is dry. This stage of curing is known as drying the leaf.

All danger from sponging or scalding is now over, and it will be necessary only to dry the mid-ribs. At this stage, the ventilators are again nearly closed at first, and completely later, while the temperature is raised 5°F. every two hours until 160°F. is reached, and maintained at this level until the stems are thoroughly dry. It is best not to exceed this temperature, as it causes the leaf to become too brittle; it may also impair the colour and greatly increase the risk of fire. To ascertain when the mid-ribs are dry, the tobacco is examined in the corners and sides of the barn, where drying is slower. Never stop firing until the mid-ribs are thoroughly dry. As soon as the mid-ribs snap between the fingers, the curing is complete, and the door and ventilators may be opened to allow the barn to cool. Normally, the curing process takes from five to six days.

During the curing, the heat should not be allowed to fluctuate too much; temperatures should be kept as constant as possible, and when necessary to raise them, it must be done gradually. Once curing is commenced, fires are kept going day and night.

When the barn has cooled down, a small fire is made in the furnace and wet bags placed over the flues to bring the tobacco to the condition in which it can be removed from the barn without breaking and damaging the leaf. The tobacco is now ready to be graded and marketed.

Formula for Curing.—The impossibility to offer a definite formula for the curing of all tobacco is obvious, for it depends entirely on the character of the leaf, climatic conditions, and many other variable factors. For reasons enumerated above, the following formula is given only to serve as a guide, and must not be applied as a hard-and-fast rule. It is good judgment and discretion in each cure that matters more than anything else, and there may sometimes be great divergences from the times and temperatures given below:—

I.—YELLOWING THE LEAF

Wanted	Temperature (Degrees F)	Time (Hours)	Remarks
Leaf yellow round edges	85-90	12-24	Sometimes even longer
Yellow to spread	95	8-14	
Yellow more pronounced	100	7-9	Open top ventilators slightly.
Yellow more distinctly	105	6-12	Open top ventilators slightly more. Open bottom ventilator slightly.
Practically Yellow	110	6-8	Open top ventilators. Open bottom ventilator more.

II.—FIXING THE COLOUR

(*When practically yellow, start fixing the colour.*)

Temperature	Time (Hours)	Remarks
115°F	5-7	All ventilators fully open.
120°F	6-7	Ventilators open.
125°F	5-7	
130°F	6-8	

III.—DRYING THE LEAF

Temperature	Time (Hours)	Remarks
135°F	5-8	
140°F	3-5	

IV.—DRYING THE MID-RIB

145°F	2	
150°F	2	
155°F	2	
160°F	12	(Or till dry)

Note.—If artificial moisture be used, remove at approximately 95°F to 100°F.

Open ventilators gradually from 100°F. to 115°F.

Close ventilators when drying the mid-ribs.

Handling and Grading.—In general principle, the handling and grading of flue-cured tobacco is similar to that of air-cured. The sticks are removed from the flue-barn after it has been conditioned as explained above, and bulked on the sticks in a suitable dry room. Care must be taken not to bulk the tobacco in too high condition, as this will cause an undue rise in temperature, and these are optimum conditions for mould growth. Inspect the tobacco occasionally to determine whether there is any such danger.

It is good practice to keep the tobacco of each barn separate, as this will greatly facilitate grading, in that there should only be a limited number of grades. The tobacco cured in successive barns generally comes from certain positions on the plant, and is, consequently, fairly uniform. Moreover, it is best to grade as soon as the barn is cured, for this eliminates the danger of keeping it in stacks for any length of time. Also the same sticks and string can repeatedly be used during the curing season, and reduces the capital outlay and the cost of production.

In grading, leaves of the same quality, that is, body, texture, colour length, width, soundness, etc., are sorted together. Trashy, damaged, green leaves and tips should be sorted into separate grades.

After the tobacco has been graded, it is tied into hands and baled in the usual way. Again, great care must be exercised not to bale the leaf in too high condition, as this might cause severe loss. The hands must be baled with the butts outwards, the bales being well protected on the sides and covered with hessian or old grain bags, to prevent damage.

Flue-cured tobacco is an expensive, high-priced, and delicate article, and certainly requires much skill and attention during all its processes of production, if good results and high prices are to be obtained. The personal element, however, plays an important role, and it depends largely on the farmer himself, other factors being equal, whether substantial profits are to be made. If the curer is careless and neglects some of his duties in the production, curing, and handling of flue-cured tobacco, great losses may be suffered, and his margin of profit turned into loss.

PRODUCTION OF WHALE OIL*

THE increasing production of whale oil as well as groundnuts and other oil seeds and nuts has an important bearing upon the copra position. This fact has been explained in an article which appeared in this Journal in February, 1930, and also in a report prepared by the Empire Marketing Board which was published in *The Tropical Agriculturist*, March 1930.

The steady increase in production shown below is further emphasised by the fact that the average annual production of whale oil between 1910-1920 was about 550,000 barrels.

The trade estimate of the quantity of whale oil coming on the market in recent years is as follows :

Year			Barrels
1925	...	...	1,044,272
1926	...	...	1,166,857
1927	...	...	1,220,415
1928	...	...	1,356,308
1929	...	...	1,861,877

The quantities produced have been greatly increased in recent years on account of the great improvement in the methods employed in the whaling industry. Although no estimate is available of production in 1930, it is expected that heavy catches will continue unless they should result in too drastic depletion of the herds.

Owing to modern methods of treatment, a proportion of the oil can be made up into a non-odorous fat suitable for human consumption, but it is not possible to say what proportion of the whale oil available for world consumption is rendered available for edible purposes.

The following brief history of whaling and its future, was delivered by Professor A. C. Hardy in a recent wireless "talk."

Every whale fishery has followed the same course—first a period of rapid development and profitable enterprise followed by collapse and final failure. By the fifteenth century the Basques had exterminated the Nordkaper whales from the Bay of Biscay—in the sixteenth century the Newfoundland fishery rose and fell. Then the Greenland whale was discovered and from the beginning of the seventeenth century to the middle of last century a series of fisheries one after the other flourished and failed, first round the coast of Spitzbergen and Jan Mayen Land in the days of great competition between the English and the Dutch and then at Greenland and far up the Davis Straits to Baffin Bay. One by one the great British whaling ports gave up. Hull, once famous for its whaling, sent its last ship in 1869—and a few ships still sailed from Dundee till the beginning of the present century.

Just when it seemed that whaling in the north was dead, Svend Foyn, a Norwegian, in 1865 invented the modern harpoon gun. This opened up a new fishery, that of the great rorqual whales which had hitherto been too fast and powerful to be attacked. Then history repeated itself once more and for many years now only a few small stations have been operating in the north. It seemed that whaling was passing altogether from the world—but no.

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* From *The Malayan Agricultural Journal*, Vol. XVIII, No. 12, December, 1930.

Reports brought back by expeditions from the Antarctic showed that there were whales in the far south. In 1904 that great Norwegain whaling Captain—C. A. Lansen—established the first whaling stations in the south of South Georgia. In the following year floating factories visited the South Shetlands still farther south. So successful were these enterprises that by 1912 there were twenty-one whale catchers working in South Georgia and thirty-two in the South Shetlands. All these islands are part of the British Empire, being Dependencies of the Falkland Islands. The Government, realising the danger to the industry, limited the number of licenses issued to the companies; but during the war when the oil became of great importance the restrictions were relaxed, and in 1915-16 the number of whales taken in a single season reached close on 12,000. If further regulations should become necessary to save the industry from decline, it was realised that it must be based on scientific knowledge. A Committee was set up with the result that the "Discovery" investigations were planned and are now being carried into practice under the leadership of Dr. Stanley Kemp. We knew practically nothing about the biology of these great whales, about their breeding habits, migrations, length of life, the time they take to reach maturity, and of the factors underlying the fluctuations in numbers from year to year. Knowledge of all these points and many others is of the utmost importance. Dr. Kemp and his staff are busy finding the answers to these questions, and much valuable information has already been obtained and is being published in the "Discovery" reports.

In the meatime new developments have taken place in the industry. Hitherto this whaling has been confined to shore stations of floating factories which must be anchored in the shelter of the land. A floating factory ship carries out all the operations just described, within her hull. The whales are flensed and cut up alongside—hence the necessity for calm water. But now in recent years a new type of floating factory has been evolved—it is known as a pelagic whaler, because it can carry out operations in mid-ocean. Huge jaw-like gates open in the bows or stern, revealing a sloping gullet from the sea up to the deck. The whales brought in taken by the catches are swallowed whole. "Surely," as some journalist has aptly said "This is Jonah avenged."

Whaling can thus be carried out without complying with local regulalations, The number of whales being taken in the Antarctic is increasing every year; some fortythousand were killed during last season. The regulation of the industry of the future must depend upon international agreement, which is inevitably slow. Let us hope that it will come before it is too late. We need not fear the complete extermination of whales, because the industry is now carried out upon such a scale that it must fail before the whales are actually brought to extinction. But there is a very real danger if care is not taken, of a collapse of the industry, with the loss of this valuable supply of oil if not for ever, for a very long time to come.

HOME MIXING OF FERTILIZERS

COMMERCIAL fertilisers are usually mixtures of materials containing nitrogen, phosphoric acid and potash. These so-called complete fertilizers may be bought ready mixed, or the ingredients may be bought and mixed on the farm. The fertilizer industry in this country is based largely on factory-mixed goods, but the practice of home mixing has always had its advocates.

For one thing, home mixing is often more economical and affords the farmer an opportunity to prepare fertilizer mixtures adapted to special needs. The farmer not only learns more about fertilizer materials but can select them himself. In many cases it is important to know what form of nitrogen to use. For example, for some crops a large proportion of a quick-acting nitrogen carrier is essential; for others a more slowly acting one, which allows the nitrogen to become available gradually throughout the season, is desirable. The home mixer can, for example, purchase sodium nitrate or ammonium sulphate and be certain that he is obtaining high-grade materials.

In some localities, the farmer has a chance to buy so-called open formula mixed fertilizers. The company states plainly the ingredients used in making the fertilizer and the pounds of each ingredient in a ton of the mixed product. This system of selling takes away one of the reasons for farmers prefering to do home mixing.

Undoubtedly home mixing is a good thing for many farmers, both financially and educationally, and should be considered where economy is necessary or desirable. Usually, where only a small amount of fertilizer is to be used, it is more convenient to buy commercial mixtures. Such mixtures may also be best adapted to the needs of the farmer who does not have the facilities for home mixing or who is not in a position to study the subject. Home mixing, however, has proved satisfactory in many parts of the country. The mixing materials commonly used are given in Table I.

* From *Leaflet* No. 70 of the United States Department of Agriculture.

Table 1—*Composition of the principal commercial fertiliser materials:*

Fertilizer material	Nitrogen	Phosphoric acid	Potash
Supplying nitrogen:	per cent.	per cent.	per cent.
Nitrate of soda	15·5-16·0	——	——
Sulphate of ammonia	19·0-20·5	——	——
Dried blood (high grade)	12·0-16·0	——	——
Dried blood (low grade)	10·0-11·0	3·0- 5·0	——
Concentrated tankage	11·0-12·5	1·0- 2·0	——
Tankage (bone)	5·0- 6·0	11·0-14·0	——
Dried fish scrap	7·0-10·0	6·0- 8·0	——
Cottonseed meal	6·5- 7·5	1·5- 2·0	2·0- 3·0
Castor pomace	5·0- 6·0	1·0- 1·5	1·0- 3·0
Calcium cyanamide	19·0-22·0	——	——
Urea	46·0	——	——
Supplying phosphoric acid:			
Steamed bone meal	1·0- 2·5	22·0-30·0	——
Ground bone (raw)	2·5- 4·5	20·0-25·0	——
Superphosphate (acid phosphate)	——	16·0-20·0	——
Treble superphosphate*	——	40·0-45·0	——
Basic slag	——	13·0-18·0	——
Raw ground phosphate rock	——	26·0-35·0	——
Ammonium phosphate	11·0-21·0	20·0-61·5	——
Supplying potash:			
Potassium sulphate	——	——	48·0-52·0
Potassium muriate (chloride)	——	——	48·0-60·0
Potassium nitrate	13·0	——	46·0
Kainit	——	——	12·0-16·0
Manure salts	——	——	20·0-30·0
Sulphate of potash-magnesium	——	——	25·0
Wood ashes	——	1·0- 2·0	2·0- 8·0
Dried sheep manure	1·51-3·09	·95-2·50	·33-2·24

* Also called double superphosphate.

PURCHASING FERTILIZER MATERIALS

In the purchase of fertilizer materials good business judgment should be used. Wide competition should be sought and prices procured not only from local merchants but from large fertilizer firms. Advice should be sought from the country agent. Best prices can be obtained for cash. Materials should be bought well in advance as this not only insures a better price but allows the use of farm labour in the winter when it is often not occupied profitably. Home mixing may be done in the barn when weather is too inclement for outside work.

MIXING COMMERCIAL FERTILIZERS

The mixing of the materials is comparatively simple. Any tight floor or a wagon box may be used, and tools at hand may be employed. The materials are spread in layers, usually the most bulky first, and are thoroughly shoveled together. The mixture is passed through a screen, and any lumps present are broken up with a tamper or the back of a shovel. The author has found a very large long-handled mortar hoe a convenient tool for mixing, but its purchase especially for this purpose is not necessary. Where large amounts, are to be mixed it would probably pay to buy a rotary mixer such as is sold for concrete mixing on the farm. The stirring should be continued until the materials are uniformly mixed and show no streaks of colour, after which the product may be bagged and stored in a dry place until applied.

To avoid caking and losses of plant-food elements, certain ingredients should not be used together in a mixture.

When taking high-analysis mixtures with concentrated materials it is well to include at least 100 to 200 pounds per ton of the mixture of some organic material, such as fish scrap, animal tankage, or cottonseed meal as a conditioner. This holds good especially when the mixture is to be stored.

One of the earliest ways to start home mixing is to duplicate a formula already in use. A beginner should select a mixture which has been successfully used on similar soil on the crop he intends to raise, get a price on the mixed goods, and then find out what a home mixture of similar analysis will cost.

In making up fertilizer formulas it is well first to decide what percentages are required and then what materials shall be used. Start with the phosphoric acid (P_2O_5). Superphosphate is almost universally used as a source of the phosphoric acid in ordinary strength fertilizers. With 16 per cent. goods if 8 per cent. of phosphoric acid is desired in the mixture, the procedure would be as follows: If the whole mixture were superphosphate, it would contain 16 per cent. of phosphoric acid; as 8 per cent. is desired, make eight-sixteenths (one-half) or 1,000 pounds of the mixture superphosphate; if 6 per cent. is wanted six-sixteenths or 750 pounds to a ton would consist of this material. Similarly with nitrogen, if nitrate of soda contains 15·65 per cent. of nitrogen and 2 per cent. nitrogen is desired, 2/15·65, or approximately one-eighth of the mixture or 250 pounds in a ton, will be needed. Similarly with potash, if potassium chloride containing 50 per cent. of potash is used and 5 per cent. potash is desired, five-fiftieth or one-tenth of a ton of potash (200 pounds) is needed.

Any other material may be used in a similar manner. It is not necessary for the farmer to be exact down to the fraction of a per cent. as fertilizer application is not an exact science and a slight variation in the calculation will not alter materially the agricultural value of the mixture.

Fertilizer materials are often used to advantage without mixing. Examples are superphosphate, basic slag, nitrate of soda, and sulphate of ammonia.

Table 2 will be of help in calculating home mixtures. In making ton lots, to get 1 per cent. use amounts shown in the first column; for 2 per cent. use those in the second column, and so on.

Table II.—*Quantities of fertilizer ingredients to be used to give definite percentages in a ton of mixture*

Ingredient	1 per cent	2 per cent	3 per cent	4 per cent	5 per cent	6 per cent	7 per cent	8 per cent	9 per cent	10 per cent
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Carriers of nitrogen (N) :										
Nitrate of soda (15 per cent N)	133	266	400	532	666	800	933	1,066	1,200	1,333
Sulphate of ammonia (20 per cent N)	100	200	300	400	500	600	700	800	900	1,000
Cottonseed meal (7 per cent N)	285	571	856	1,142	1,428	1,714	2,000			
Dried blood (10 per cent N)	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
Fish scrap (8 per cent N)	250	500	750	1,000	1,250	1,500	1,750	2,000		
Carriers of phosphoric acid (P_2O_5) :										
Superphosphate (16 per cent P_2O_5)	125	250	375	500	625	750	875	1,000	1,125	1,250
Superphosphate (20 per cent P_2O_5)	100	200	300	400	500	600	700	800	900	1,000
Double superphosphate (40 per cent P_2O_5)	50	100	150	200	250	300	350	400	450	500
Ground bone[2] (23 per cent P_2O_5)	87	174	261	348	435	522	609	696	783	869
Carriers of potash (K_2O) :										
Potassium sulphate (50 per cent K_2O)	40	80	120	160	200	240	280	320	360	400
Potassium chloride (50 per cent K_2O)	40	80	120	160	200	240	280	320	360	400
Kainit (12.5 per cent K_2O)	160	320	480	640	800	960	1,120	1,280	1,440	1,600
Manure salts (20 per cent K_2O)	100	200	300	400	500	600	700	800	900	1,000

[1] Where the combined material do not total 2,000 pounds, a filler may be used to bring up the mixture to that weight.

[2] Ground bone also carries nitrogen.

EXAMPLES

To make up a ton of a 4-8-4 mixture in which the nitrogen is one-third ($1\frac{1}{3}$ times 133 pounds = 178 pounds) in the form of nitrate of soda, one-third in the form of sulphate of ammonia, and one-third in organic form from cottonseed meal, the phosphoric acid is from 16 per cent. superphosphate, and the potash is from 50 per cent. potassium chloride (also known as potassium muriate), the following materials would be used:

	Pounds
Nitrate of soda	178
Sulphate of ammonia	134
Cottonseed meal	380
Superphosphate (16 per cent.) ...	1,000
Potassium chloride	160
Filler (ground dried peat)	148
Total	2,000

Since the fertility materials add up to 1,852 pounds, 148 pounds of a filler is added. This filler may be a conditioner as well and often has some fertilizer value in itself. Dried peat ground phosphate rock, ground limestone, or even sand may be used. The total is so near 2,000 pounds that it may be considered unnecessary to bother with a filler. When the total of the mixture is appreciably less than 2,000 pounds, it may be perfectly satisfactory to use a smaller quantity of fertilizer per acre rather than to dilute with filler. Thus, if you are making a ton of 4-8-4 mixture, in which the sum of the materials used is 1,500 pounds without filler, by using three-fourths of the normal application, the filler can be omitted.

The mixture just given is a good general fertiliser. Its nitrogen is in different degrees of availability. The cottonseed meal in this mixture, besides its fertilizer value, is an excellent conditioner.

A HOME FOR EMPIRE INSECTS*

"ROGUES' GALLERY" FOR THE KING'S SIX-LEGGED ENEMIES

BOXES OF BEETLES

SIX million insects have "moved house" into the new wing built by the Empire Marketing Board at the Natural History Museum, which was opened recently by the Archbishop of Canterbury. Acute over-crowding in the insect rooms, which contain specimens from every corner of the world has made necessary a new building for their display.

The collection is a sort of "rogues' gallery" for the use of the men who are policing the Empire's most destructive and dangerous criminals —the insect pests. If a new insect crook tries to put an Empire crop "on the spot" the entomologist's first act, like the detective's, is to identify the pest and to get its dossier from the criminal records. This information tells him the criminal's habits and methods of working and helps him to find ways and means of outwitting the enemy.

INSECT GENERAL POST

Farmers, medical officers, missionaries, commercial men, and agricultural specialists send specimens to be identified from all parts of the Empire. By every morning's post arrive boxes containing an unknown beetle from the West Indies, a moth which is ruining crops in Fiji, an ant which lives on railway sleepers in Palestine, or a fly suspected of carrying some fatal disease in Central Africa. These are filed in special wooden specimen cases and scientists study such delicate signs as the insect's lower jaw or the pattern of the veins on its wing to find its exact place in the tribe.

Advice on practical control measures, also, is given. The new building contains "controlled temperature" rooms where the insects can be reared under tropical conditions even in an English winter. Their life-histories can then be studied and certain methods of destruction tested.

TWO STRANGE COLLECTORS

Three-quarters of a million butterflies are arranged in one of the new rooms and have a romantic history. Two brothers who lived near Rheims, in France, collected insects as a hobby. One devoted himself to beetles; the other collected butterflies, and by the end of his life had amassed one million specimens. When the collection came up for sale the Natural History Museum acquired the bulk of it. Then the butterflies, the most fragile of cargoes, had to be transported to London. They were taken across France by road, shipped with tender care over the Channel and finally delivered in South Kensington in thirteen specially padded vans.

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* Empire Marketing Board Publication, 1930.

Other insects have reached the Museum in odd ways. A bookseller bought an ancient cabinet of books in which he found a number of dead butterflies. They turned out to belong to an old English species which had since become extinct and to be worth ten guineas each. They now repose in the new insect wing. Attempts have been made to re-introduce several species of butterflies which had become extinct into butterfly sanctuaries in East Anglia.

MOTHS FROM AN OIL-FIELD

Some other valuable moths were collected by an engineer on a South American oil-field. "The desire of the moth for the flame" drove them to beseige his flares when he was working at night. Other specimens have been sent in by army officers who take up "bug-hunting" in their spare time in Iraq, Egypt, Aden, and the Frontier.

The insect wing will provide room for scientists from overseas who wish to work at the Museum. Nowhere else in the Empire can they find so complete a collection, and the new accommodation should prove another valuable weapon in the war against insect pests, for which the Empire Marketing Board has already allocated some £200,000. The Natural History Museum does for insects much what Kew does, through its Herbarium, for the plant world.

MEETINGS, CONFERENCES, ETC.

BOARD OF AGRICULTURE

Minutes of a meeting of the Board of Agriculture held in the board-room of the Department of Agriculture, Peradeniya, at 2 p.m. on Monday, October 20, 1930.

His Excellency the Governor, President of the Board of Agriculture, presided.

The following members were present:

The Director of Agriculture; Sir Solomn Dias Bandaranaike, K.C.M.G.; Mr. C. W. Bibile; Mr. J. P. Blackmore; Mr. R. G. Coombe; Mr. H. L. de Mel, C.B.E.; the acting Director of Irrigation; Mr. Chas. A. M. de Silva; Mr. Wace de Niese; Mr. F. R. Dias; the Divisional Agricultural Officers, Central, Southern, South-Western and North-Western Divisions; Mr. C. Drieberg; the Economic Botanist; the Entomologist; the Hon'ble Sir Marcus Fernando; Gate Mudaliyar G. A. Goonetilleke; the Government Agent, North-Western Province; the Hon'ble Mr. D. H. Kotalawala; Mr. D. J. Malcomson; the Manager, Experiment Station, Peradeniya; the Hon'ble Mr. T. B. L. Moonemalle; Mudaliyar S. Muttutamby; Mr. C. Muttyah; the acting Mycologist; Mr. Graham Panditte-sekera; Mr. S. Pararajasingham; Gate Mulaliyar A. E. Rajapakse; Mudaliyar M. S. Ramalingam; Mr. L. F. Roundell; the Hon'ble Mr. D. S. Senanayake; Mr. N. D. S. Silva; Mr. Rolfe Smerdon; Adigar W. A. Udugama; Mudaliyar S. M. P. Vanderkoen; Mr. T. Wallooppillai; Mr. A. A. Wickremasinghe; Rev. Fr. L. W. Wickremasinghe; Mr. Huntley Wilkinson; Mr. J. I. Gnanamuttu (Secretary).

Visitors: Mr. C. V. Brayne; Mr. A. M. Clement Dias; Mr. S. J. F. Dias; Mr. Reginald M. Fernando; Mr. N. K. Jardine; Mr. C. N. E. J. de Mel; Mudaliyar R. C. Proctor; Mudaliyar C. Rasanayagam; Mudaliyar N. Wickremaratne.

Letters and telegrams regretting inability to attend the meeting were received from the following: Mr. L. G. Byatt; Mr. J. Carson Parker; Mr. J. Horsfall; Dr. T. B. Kobbekaduwa; Mr. D. B. Moeran; Mr. Sheridan-Patterson; Mr. A. W. Reid; Mr. A. T. Sydney Smith; Mr. J. H. Titterington.

AGENDA ITEM No. 1.—MINUTES

The minutes of the meeting held on February 20, 1930, copies of which had been circulated to members, were taken as read and were confirmed and signed by the President.

AGENDA ITEM No. 2.—NOMINATIONS TO COMMITTEES

On the motion of Sir Marcus Fernando, seconded by Mr. Wace de Niese, the meeting approved of the following appointments to fill the places of members who had gone on leave, or to fill vacancies created by resignations:

ESTATE PRODUCTS COMMITTEE

Lieut.-Colonel G. O. Hunt, in place of Lieut.-Colonel J. A. M. Bond, resigned.

Mr. L. G. Byatt, in place of Mr. G. L. H. Doudney, resigned.

Mr. J. Carson Parker, to act for Mr. J. W. Ferguson, on leave.

Mr. D. B. Moeran, to act for Mr. A. W. Ruxton, on leave.

Mr. D. J. Malcomson, to act for Mr. C. C. du Pré Moore, on leave.

Mr. Rolfe Smerdon, to act for Mr. B. M. Selwyn, on leave.

FOOD PRODUCTS COMMITTEE

Rev. Fr. L. W. Wickremasinghe, in place of Mudaliyar S. P. Wijetunge, transferred from Hambantota.

AGENDA ITEM No. 3.—AMENDMENT OF RULES

Mr. T. H. Holland moved that rule No. 2 of the rules framed under Ordinance No. 37 of 1921 be amended, substituting the Tuesday before the second Wednesday, for the holding of meetings of the Estate Products Committee, instead of the second Thursday of the months of January, March, May, July, September and November. Mr. Holland explained that the amendment was in consideration of the fact that the general committee meetings of the Planters' Association of Ceylon were held on the dates now suggested. Mr. C. A. M. de Silva seconded the motion, which was carried.

AGENDA ITEM No. 4.—RESOLUTION OF PADDY CULTIVATION

Mr. H. L. de Mel, C.B.E., proposed the following resolution which had been formulated by a Sub-Committee of the Food Products Committee appointed for the purpose of taking action on the Reports of the Local Committees.

That a Commission be appointed by Government to enquire into and make recommendations with regard to the possibility of increasing paddy production in the Island in the light of information in the reports submitted to the Food Products Committee by District Sub-Committees, especial attention being given, amongst other points, to the following :

(1) Improvement of irrigation facilities so as to meet the needs specified in the reports.

(2) Organisation and co-ordination of the services concerned with the cultivation of paddy, as Agriculture, Irrigation, Revenue, Forestry, Animal Husbandry and any others (here should be considered provision of pasturage and fencing).

(3) Tenancy conditions (consolidation of infinitesimal shares in land, alienation of new lands under such conditions as to prevent the system of infinitesimal shares, and the impediment of the existing share system of rental.)

(4) The marketing question (credit, supply of seed paddy and manure).

(5) Anti-malarial and other public health measures.

(6) The improvement, where necessary, of means of communication.

(7) Provision of efficient drainage and flood protection, including the clearing of elas.

Mr. de Mel explained at length how the present recommendations had emanated from a resolution passed at the Agricultural Conference of May 1928, as a result of which Local Committees had been formed to investigate the question of paddy cultivation in all its aspects in their district and to report to the Food Products Committee. Those reports, together with a synopsis of them were now in the hands of the members. He thought that an unofficial body like the Food Products Committee could only make a recommendation to Government and that the details should be considered by a Commission to be appointed by Government.

In seconding this resolution Mr. C. Drieberg urged the necessity of closer co-operation between the Departments which are concerned with rural economy and hoped that with such co-operation it would be possible to make paddy cultivation a national industry such as it is in Japan.

The Hon. Mr. D. S. Senanayake opposed the resolution as in his opinion no useful purpose would be served by the appointment of a Commission, which being not an administrative body, could only submit a report. He suggested that the Director of Agriculture could establish a close association with the Treasury and other Government Departments and give effect to the recommendations before them.

His Excellency said that, without a desire to influence the decision of the Board, he thought that if a Commission were appointed it would have to include representatives from other departments so that all the questions involved in the inquiry would receive due consideration. If the matter were referred to the Director of Agriculture it would obviously be necessary for him to consult other departments and set up an inter-departmental committee presided over by himself. The difference between that and a Commission was that on a Commission the official representatives would have the advantage and benefit of unofficial colleagues who would bring to bear their local knowledge and experience which might not be available to a departmental committee.

Mr. C. V. Brayne remarked that a Commission with terms of reference such as the one proposed would be overloaded. Four or five distinct and different subjects were involved and the proposed Commission would probably have to be as large as the Land Commission. If the work was to be done expeditiously and efficiently a small body of 3 to 4 members was the ideal. With regard to item (2) of the resolution, the organisation and co-ordination of the services concerned with the cultivation of paddy would automatically happen under the New Constitution and he doubted the usefulness of a Commission anticipating that event.

His Excellency suggested that the difficulty contemplated by Mr. Brayne could be averted by the Commission dividing itself into sub-committees to deal with the various groups of subjects. This was done with good results by the recent Colonial Conference in London, upon which he was and, although they were a very large body, they had dealt with a considerable variety of subjects. In the same way, if they appointed a Commission, the best way for it to conduct its operations would be to divide itself into sub-committees, the main Commission acting as a co-ordinating and general advisory body.

The Colonial Secretary observed, in reply to further remarks by Mr. Senanayake, that the Commission would be in a position to recommend to Government the order in which the desirable works ought to be taken up as the money became available. He suggested as a formal amendment the substitution of the words "the Government be requested to appoint a Commission" for the words "that a Commission be appointed."

His Excellency the Governor added that the Commission could adopt very much the same procedure as that followed by the Public Works Advisory Board.

The Hon. Mr. W. A. de Silva stated that it would be three years before the Commission concluded its labours, such was the case with the Landless Villagers Commission and others. He thought that if the Director of Agriculture would go into the recommendations of the sub-committees and place his own proposals before Government some definite policy could be initiated. It was necessary that whatever was to be done should be undertaken without delay. This view was supported by Mr. A. A. Wickremasinghe.

Mr. L. Lord pointed out that the recommendations of the Food Products Committee were of necessity made with a view to their consideration by a responsible Commission. They were by the conditions under which they were compiled of necessity incomplete. The sub-committees had not had the benefit of the views of Irrigation and Revenue Officers.

Mr. T. Wallooppillai supported the resolution.

Sir Marcus Fernando thought that only a Commission could judge between the recommendations that were essential and those that were not. He feared that the adoption of the recommendations in their entirety was out of the question. If action on all were attempted at once the entire resources of the Island would be required to carry them out. To the most important effect should first be given. He agreed with Mr. Brayne that the question of co-ordination of the services, equally with that of anti-malarial measures, should be eliminated from the deliberations of the Commission. He supported the appointment of a Commission because he thought that a start must be made without further delay.

On the invitation of the President, the Director of Agriculture said that, if he was to undertake the work single-handed, he would have to ask permission to form a Commission himself. In the matter of water supply he would have to consult the Director of Irrigation; in regard to transport facilities the Railway authorities; and in regard to marketing the Co-operative Department. A Commission armed with the authority of Government was necessary. He had had no part in the recommendation that a Commission should be appointed, but he was very glad when the Food Products Committee took that line.

The resolution was then put to the House and was carried, 36 voting for and 3 against.

The suggested terms of reference were then put *seriatim* and were carried, with the exception of items (2) and (5) which were deleted.

At the suggestion of Mr. A. A. Wickremasinghe the subject of rural agricultural education was accepted for inclusion in the terms of reference to the Commission.

The Colonial Secretary suggested that item (6) means of communication, might be included under the same sub-head as the marketing question.

His Excellency concluded this discussion by stating that the exact terms of reference would be re-drafted in due form.

AGENDA ITEM No. 5.—THE CULTIVATION OF LARGE AREAS OF PADDY BY GOVERNMENT

Attapattu Mudaliyar W. Samarasinghe moved the following resolution:

> That in the opinion of this Board it is desirable that appreciably large tracts of land should be cultivated with paddy by the Department of Agriculture, under varying conditions of climate, water supply, and health condition, so as to demonstrate the practicability of making the cultivation of paddy a remunerative industry.

He said that, instead of trying to improve paddy growing by mere instruction, the Department should, by taking up land and cultivating it, demonstrate the soundness of scientific theories.

The Hon. Mr. D. S. Senanayake seconded the resolution and added that the best way to get into touch with the goiya was by the creation of demonstration plots as suggested.

His Excellency expressed sympathy with the principle of the resolution and said that the Director of Agriculture had already expressed the opinion that demonstration should be given on the goiya's land and this was in agreement with the principles of the motion. He did not approve of the phrase "appreciably large tracts," as Government was not organised to conduct agricultural operations on a large commercial scale.

The Colonial Secretary suggested that the phrase "appreciably large tracts of land" be amended to read "tracts of land of suitable size."

This amendment was accepted by the mover and seconder, and the resolution so amended was carried.

AGENDA ITEM No. 6.—MEANS OF PROMOTING PADDY CULTIVATION

On the suggestion of the President, Gate-Mudaliyar G. A. Goonetilleke agreed that the following resolution which stood in his name be not debated but be referred to the proposed Commission as many of its suggestions were already included in the terms of reference of the Board's Resolution on Paddy Cultivation.

That Government should endeavour to promote intensive and extensive paddy cultivation by the following means:

(1) Repairing or restoring all minor irrigation works now in disuse or disrepair; clearing and maintaining in good order all channels, water-courses and elas under the superintendence of an officer of the Agricultural Department in collaboration with the chief headman.

(2) Making it obligatory on owners of paddy fields to cultivate them by levying a rate or tax on uncultivated paddy fields: giving all Crown paddy land free to applicants for cultivation for a specified period; if there are no applicants for Crown lands and the lands are extensive, by cultivating them under the direction of the Agricultural Department.

(3) Buying up all available paddy, setting up rice mills at different centres and selling the rice to local merchants for retail sale at a lower rate than imported rice, fixing the maximum price.

(4) Giving every facility for transport by public conveyance.

(5) Spreading agricultural knowledge by training village lads with landed interests at an agricultural school free of charge, and appointing such trained men as field officers on a small monthly stipend (Rs. 20/- or thereabouts) to function under the direction and control of the Government Agent.

(6) By having in each locality a model field cultivated under the direction of the Agricultural Department and an agricultural officer periodically visiting each field on a specified day to give demonstrations of improved methods of cultivation.

(7) By giving public recognition in the shape of honorary ranks to those who are instrumental in bringing paddy land under cultivavation.

(8) By directing the Agricultural Department to subordinate all non-urgent activities to an intensive campaign for paddy cultivation.

(9) As the Farm School in the Southern Province has not turned out to be the success that was expected, that premises and appliances be used to give the vernacular school boys of the neighbourhood instruction in the cultivation of foodstuffs side by side with their usual school course, thus instilling into them from their childhood the means of developing their agricultural instinct.

In closing the day's proceedings, His Excellency the Governor expressed the hope that something definite and tangible would result from the work of the proposed Commission. He trusted that the deliberations of that day would not prove nugatory, but result in great benefit to the permanent population of the Island. Any help that Government could give would be given gladly within the limits of the resources of the State. Some of the items which the Commission would consider such as tenancy conditions would not need expenditure at all and he trusted the Commision would be able to send in an interim report dealing with that aspect of the problem.

His Excellency thanked the members for their attendance and support.

JOS. I. GNANAMUTTU.
Secretary,
Board of Agriculture.

Peradeniya, October 28, 1930.

TEA RESEARCH INSTITUTE AND LONDON MARKET

BOARD'S POLICY ON APPLICATIONS FOR EXPERIMENTS

A meeting of the Board of the Tea Research Institute of Ceylon was held in the G.O.H., Colombo, on Wednesday, October 1st, 1930.

Present.—Mr. R. G. Coombe, (Chairman), the Hon. Mr. D. S. Senanayake, Mr. A. G. Baynham, Mr. F. F. Roe, Maj. H. Scoble Nicholson, Messrs. J. D. Finch Noyes, G. R. Whitby, John Horsfall, Jas. Forbes (Jnr.), T. B. Panabokke, R. R. Muras (Acting Assistant Secretary) and by invitation Dr. R. V. Norris (Director, Tea Research Institute).

Letters regretting inability to be present at the meeting were received from the Colonial Treasurer and the Director of Agriculture.

FINANCE

Referring to the accounts to the end of August, the Chairman stated that he had gone carefully into the financial position to the end of the current year. He anticipated that there should be a small balance in hand to carry forward to next year, after paying for all building work now nearing completion. The second instalment of the loan from Government, he stated, had been paid a few days prior to the meeting.

The accounts were approved without further comment.

INCREASE OF TEA CESS

A letter from the Colonial Secretary was read stating that the proposed alteration to the Ordinance had been approved by the Executive Council, and a draft of the Ordinance was now being published in the "Gazette" prior to the matter coming up before the Legislative Council.

ESTIMATES SUB-COMMITTEE

On the motion of the Chairman, the Board appointed the following to constitute a Sub-Committee, to consider the draft estimates for 1931: the Chairman, the Director, Tea Research Institute, the Superintendent, St. Coombs, Mr. F. F. Roe and Mr. John Horsfall.

MEMBERS OF THE BOARD

The thanks of the Board were recorded to Mr. A. S. Collett for his services during Mr. Finch Noyes' absence.

BUNGALOWS

Architect's Reports Nos. 15 and 16.—The Director reported that two of the senior staff bungalows had been taken over at the end of September, and Dr. Evans was being transferred to St. Coombs that week. It was anticipated that the two remaining bungalows would be completed by the end of November. Progress was now satisfactory, and the work would be finished under the contract time. The contractors had also made good the defects in the Superintendent's bungalow, and during the recent bad weather no further trouble from leaks had been experienced.

ST. COOMBS ESTATE

Lay-out of Grounds.—At the request of the Chairman, the Director informed the Board that he had been able, through the courtesy of the Director of Agriculture, to secure the advice and assistance of Mr. Parsons

in the laying out of the grounds. Mr. Parsons had already paid one visit and arrangements had been made for supplies of hedge cuttings, ornamental shrubs and trees. It was hoped to have the work completed before the Conference in February.

The Chairman expressed the Board's appreciation of the help given in this matter by the Director of Agriculture and Mr. Parsons.

VISITING AGENT'S REPORT

The Chairman explained that the present report had been made by Mr. Baillie-Hamilton owing to Mr. Ferguson's absence on leave. The report was a satisfactory one and had been considered on the previous day by the Experimental Sub-Committee. The minutes of this meeting were not yet available, but certain of the suggestions made would now be referred to the Board for consideration.

Cart Road and Bridges.—The Chairman said the position in regard to the Mattakelle cart road was not altogether satisfactory. The Board had given an undertaking to maintain the road in good repair and the necessary steps to implicate this undertaking would be carried out as soon as the present abnormal heavy traffic, due to the building operations, was over. The Superintendent had been instructed to prepare estimates for the work.

New Clearings.—The Chairman reported that the Experimental Sub-Committee had supported the Visiting Agents's suggestions that these clearings should be manured.

The Chairman also called attention to Mr. Baillie-Hamilton's suggestion that "Acacia Decurrens" should be planted out in the clearings. Mr. Ferguson was known not to favour the use of this tree, the Experimental Sub-Committee had in consequence recommended as a temporary measure that "Tephrosia vogelli" should be put in pending further discussion of the point after Mr. Ferguson's return. Both Messrs. Forbes and Horsfall said that they had found "Acacia Decurrens" very satisfactory. After some discussion, the Board confirmed the recommendation of the Experimental Sub-Committee.

Manurial Policy.—Referring to the question of manure generally, Major Scoble Nicholson suggested that competitive quotations should be obtained for manures required for the estate, and the Board supported this proposal.

Mr. Roe asked at what time pruning mixture was applied and was informed by the Chairman that this was usually done about the time of pruning. Several members referred to the possible advantage of applying pruning mixtures before pruning. The Director, replying to these questions, said there were at present available no definite data as to the best time to apply pruning mixtures. The question was an important one to which he had already called attention, and the matter would certainly receive the consideration of the Scientific Staff.

Nurseries.—The Chairman called attention to the note in the current number of *The Tea Quarterly* describing the condition found in the nursery beds at St. Coombs, where there had been considerable trouble with unhealthy seedlings. The Director amplifying this note stressed that no evidence of fungus and insect pests had been found, and the trouble seemed chiefly to be due to the moisture conditions in the higher part of the slopes. Applications of manure had not proved helpful but when the rains set in, conditions had much improved. Before this surface watering had been relatively ineffective owing to the nature of the soil which easily caked forming a hard pan.

Considerable quantities of plants would be required for further openings, and the Board discussed the question as to whether further nurseries should be laid down at St. Coombs, or efforts made to secure stumps from elsewhere. In this connexion it was pointed out that there were many advantages in establishing nurseries in St. Coombs, particularly as this would facilitate the selection of suitable material for the experimental areas.

The Board decided that nurseries should be established at St. Coombs, and asked the Visiting Agent and Superintendent to select a suitable site for these.

TEAS FOR THE LONDON MARKET

The Chairman stated the proposal that the Institute's teas should be sold in London for a year had originated in a resolution proposed by Mr. P. G. Edwards, at a meeting of the Uva Planters' Association, and had been passed on to the Parent Association. He had referred the proposal to both the Visiting Agent and Superintendent, who were both of the opinion that the present crop was too small to receive the same attention on the London market that it did on the local one—an opinion which, he personally and the other planting members of the Board were in agreement with.

When the matter was discussed by the Planters' Association at its last Committee Meeting, he had expressed these views, emphasising at the same time that the Board would, he felt sure, be in sympathy with the proposal and that when the crop from the estate shewed a material increase would be prepared to reconsider the matter.

The Chairman, continuing, reported that a few days prior to the meeting a letter had been received from Messrs. Geo. Steuart and Co. in the same connexion, which the Secretary would now read:

Geo. Steuart & Co.,
Colombo, September 16th, 1930.

The Secretary, Tea Research Institute, Nuwara Eliya.

Dear Sir,—With reference to the suggestion recently put forward by Major Edwards at a meeting of the Uva Planters' Association, to the effect that teas suitable for the London market, as well as for the Colombo market, should be made at St. Coombs, we are instructed by the London Secretaries of the Standard Tea Company of Ceylon, Ltd., for which we act as local agents, to give full support to this proposal.

The Standard Tea Company of Ceylon, Ltd., as a large London Company and a subscriber to the Tea Research Scheme rather feels, we gather, that the present tendency is to study local rather than London interests and perhaps you would be so good as to let us have your views on the subject.—We are, Dear Sir, Yours, faithfully, Geo. Steuart & Co.

The Board supported the Chairman's view that it was not in the interests of the Institute to give effect to the suggestion made in the Uva Planters' Association's resolution for the present.

It was further decided that half chests of the three principal grades should be sent to the Ceylon Association in London, with the request that reports should be obtained from the leading brokers and buyers, connected with the London market.

The Chairman further reported that he had been informed that about half of the present crop sold on the local market was exported to London, the major part of the balance being bought for export to Australia and America.

SEWAGE DISPOSAL ESTIMATES

The Board confirmed the Chairman's action in sanctioning the revised estimates drawn up on the advice of the Sanitary Engineer.

ELECTRIC LIGHT AND POWER CABLES

The Chairman requested the Board's sanction for the expenditure for electric light and power cables at St. Coombs, viz: (1) Power House to Laboratory; (2) Continuation from Laboratory to senior staff bungalows; (3) Power house to present junior staff bungalows; and (4) Extension of No. (3) to additional junior staff bungalow site.

The Board sanctioned the expenditure.

FACTORY EXPERIMENTS

The Chairman said that several applications had now been received from firms and private individuals for the test of plant or systems of manufacture at St. Coombs Factory, and it was necessary for the Board to define its policy in dealing with such applications. The matter had been very fully discussed by the Experimental Sub-Committee which had decided to recommend to the Board the following procedure:

(1) On receipt of such applications, the firm or individual concerned shall be requested to give facilities to the Institute staff to visit a factory in which such plant or process is being worked and to take such observations as may seem necessary in order to assess the scope and value of the process. Such preliminary data will, of course, be confidential and not for publication.

(2) The Institute staff will then report to the Experimental Sub-Committee who will consider the application in detail and make a recommendation to the Board as to whether the proposals should be entertained or not.

(3) The capital cost of installing any such plant should be met by the firm or individual desiring the test to be carried out, and, in the event of the tests being unfavourable, the firm or individual may be required to remove the plant, and, if necessary, restore the original conditions.

(4) In regard to all such work, the Institute will retain full liberty to publish in *The Tea Quarterly* or Institute Bulletins all data obtained whether favourable or otherwise.

(5) In installing any such experimental plant it would seem desirable to obtain a certificate from the firm or individual concerned that the installation as carried out meets their requirements in providing proper facilities for an adequate trial.

After full discussion the Board approved the recommendation of the Experimental Sub-Committee.

Experimental Machinery.—Reported that the two experimental rollers had now been shipped and were shortly expected in Ceylon.

One bank of tats had been constructed and work on the roll breaker and drier was well advanced. It was expected the experimental machinery would be installed about the end of the month.

LABORATORIES

Reported that notice had been given terminating the leases of "Lindfield" and Mahagalla bungalows from December 31st, 1930.

The Director reported that work on the Laboratory had been delayed by the non-arrival of the acid-proof piping. It was anticipated that the building would be completed about the middle of December.

STAFF

Senior Scientific Staff.—The annual increments due to Dr. Norris, Mr. Eden and Dr. Evans were approved.

Renewal of Dr. Evans' Agreement.—Reported that Dr. Evans was proceeding on leave early next year, and that his present agreement terminated on September 5th, 1931.

Resolved unanimously to renew Dr. Evans' agreement on the present terms for a further period of five years from September 6th, 1931. Decided that in the new agreement, Dr. Evans' official designation should be that of "Biochemist."

Junior Staff Provident Fund.—Reported that a simplified scheme for this fund was now under consideration and a further report would be submitted before the next meeting.

New Appointments.—Reported that Mr. D. G. de Zilva had been appointed as 2nd clerk as from September 18th.

EMPIRE MARKETING BOARD

The following letter from the Director of Agriculture was read:

No. A2397, Department of Agriculture,
Peradeniya, 17/21 July, 1930.

(*Grant to the T. R. I. from the Empire Marketing Board.*)

Sir,—Adverting to correspondence ending with my letter No. A2115 of May 14th, 1929, I have the honour to forward herewith a copy of a letter received from Government on the subject of grant to the Tea Research Institute from the Empire Marketing Board.—I am, Sir, Your obedient servant, (Sgd.) W. Youngman, Director of Agriculture.

The Director, Tea Research Institute of Ceylon,
Nuwara Eliya.

No. A. 2/30, Colonial Secretary's Office,
Colombo, July 15th, 1930.

(*Grant to the T. R. I. from the Empire Marketing Board.*)

Sir,—With reference to your report No. A2395 of the 4th February, 1930, on the above subject, I am directed to forward herewith for your information a copy of despatch No. 303 of the 13th June, 1930, and its enclosures received from the Secretary of State for the Colonies, and to request you to inform the Tea Research Institute of the sanction by the Empire Marketing Board of a capital grant not exceeding £1,000 to the Institute for the purchase of machinery and plant for the factory, payment to be claimed through this Government on detailed vouchers shewing the machinery, etc., purchased.

2. As regards the Institute's application for grant of £2,000 a year for three years for an invtstigation of the biological control of insect pests of tea and other crops you may inform them that the matter is still under consideration.—I am, Sir, Your obedient servant, (Sgd.) J. C. Jansz, for Colonial Secretary.

The Director of Agriculture,
Peradeniya.

Reported that no further information had been received in regard to the application for a grant for parasite work.

TEA RESEARCH CONFERENCE

On the suggestion of the Chairman, the following Sub-Committee was appointed to make arrangements for the T. R.I. Conference:

The Director, the Chairman, Mr. Forbes (Jnr.), and Mr. Huntley Wilkinson.

Attention was called by Mr. Baynham to the fact that the Census had now been fixed for February 26th and 27th, and it might therefore be necessary to change the date of the Conference.

CONTRACT FOR JUNIOR STAFF BUNGALOWS

The Board confirmed the action of the Chairman in allotting to Messrs. Hemachandra and Co., the contract for the construction of Nos. 5 and 6 junior staff bungalows.

The meeting terminated with a vote of thanks to the Chair.

DEPARTMENTAL NOTES

PROGRESS REPORT OF THE EXPERIMENT STATION, PERADENIYA

FOR THE MONTHS OF NOVEMBER AND DECEMBER, 1930

TEA

A further thinning of the *Albizzias* in plot 150 was undertaken in December as it is not intended to lop these trees in future. The trees were uprooted with a monkey jak.

RUBBER

Brown Bast

In December an examination was made of sixty-one trees which had been treated for brown bast in 1926.

The trees can be divided into three classes according to their present condition :

1. Trees of which the treated area cannot be tapped again on account of uneven renewal, numerous large nodules, large wounds, deep grooves etc : 10 trees or 16% of the number treated.
2. Trees of which the treated surface can be tapped, but with difficulty : 17 trees, or 28% of the number treated.
3. Trees of which the treated area can be tapped again without difficulty : 34 trees, or 56% of the number treated.

In none of the above trees has the treated surface yet been tapped again and it is therefore not possible to give an opinion on the principal criterion of success, *i.e.*, whether the disease re-appears on the principal criterion is tapped. In some cases there are indications that the disease is still present in the renewed bark. It is thought that in some instances the excessively uneven surface that has resulted from treatment might have been avoided to some extent by taking greater care not to scrape down to the wood, and by the subsequent regular removal of nodules while they were still small. These points are now receiving greater attention. It is also probable that in some of the trees which now exhibit an untappable surface the disease was present in a fairly advanced state before treatment was undertaken. It is clear that early and regular treatment followed by periodic removal of nodules is essential if losses are to be avoided.

The Rejuvenation Experiment

Plot 2 of this experiment is now in its second and last year of tapping. The two cuts were due to be changed over to the other side at the end of the first year. In some cases, however, the cuts had already been changed over as the first cuts had gone dry, and in some cases these second cuts had also gone dry. In the latter contingency tapping has been resumed on the first cuts, and thereafter whichever cuts have latex are tapped.

A point which has not received previous attention in this rejuvenation experiment is the rubber content of the latex from the trees under intensive tapping. The figures for the first year are given below :

Plot and Treatment.	No. of grammes of dry rubber in 100 c.c. of latex.
1. Daily tapping on two half-spiral cuts. Bark consumption 2 inches per month	23·57
2. Daily tapping on two half-spiral cuts. Bark consumption 1 $\frac{2}{3}$ inches per month.	24·44
3. Daily tapping on two half-spiral per month.	27·35
4. Tapping daily on alternate months with 1 $\frac{2}{3}$ in. bark consumption per tapping month. cuts. Bark consumption 1 $\frac{1}{2}$ inch.	31·47

It will be seen that the rubber content of latex is in all cases lower than normal and that it is lowest in the plots where the tapping is most severe and bark consumption is largest.

The New Avenue Rubber Manurial Experiment

The second annual application of manures was made in December according to plan.

Tapping of Budded Rubber, Plot 164

In May, 1930 tapping of 90 budded trees at three different heights was started. Thirty trees are tapped at 5 feet from the ground, thirty at 3 feet, and thirty at 1 foot. The trees comprise twelve small clones.

Yields for the first 6 months of tapping are as follows :

Height of tapping	Grammes of dry rubber per tree for 6 months, May 1st to October 31st, 1930.
5 feet	392·5
3 feet	436·4
1 foot	483·0

It will be seen that these figures indicate an increased yield as the cut gets nearer the base, though probably not such a sharp increase as is found in seedling rubber. It has been stated in Malaya that the yield from a cut approaching the point of union of stock and scion is negligible. Experiments in the Dutch East Indies indicate that the optimum tapping height varies with the clone. When longer records are available from these trees the figures will be compared in detail with figures from other countries.

CACAO

The cacao crop matured rather earlier than usual and, as always, absorbed all available labour in November. The crop was a large one but pod disease, as well as helopeltis, was much worse than usual and the proportion of black cacao will be unusually high.

During November visits were paid to the following cacao estates in connection with cacao selection work : Katugastota Estate, Kondesalle Estate, Pallekelly Group, Rajawella Estate, and Maria Estate. Thirty-nine trees have been selected for recording of individual yields on these estates, and pod records are being maintained by the Superintendents from November 1st, 1930. Sixty-nine trees on the Experiment Station were also selected for the same purpose and similar records are being kept from November 1st.

In December all the trees bearing pods in the Economic Collection cacao plots were examined and those trees not bearing pods true to the desired type were cut out. They will be replaced with budded plants of the desired type.

In eight out of the nine plots planted one or more trees were found bearing pods typical of the variety to which the plots are allotted. All vacancies are already planted with seedlings and these will be budded when large enough.

GREEN MANURES AND COVER PLANTS

In the Iriyagama Division a parasitic *Cuscata* was observed growing on *Calopogonium mucunoides*. The parasite had spread from a piece of waste land.

FRUIT

Two lines of work on grape fruit have been decided upon :

1. A field test of the varieties already imported. This will entail considerable propagation of plants by budding on the same type of stock—probably pumelo, as these stocks are most easily obtainable in quantity.
2. A test of four different stocks for grape fruit viz., pumelo, Seville orange, grape fruit and nattaran lemon. Seed of the latter variety has not yet been obtained but nursery beds of the other three have been laid down.

A spraying experiment was started by the Mycologist on young imported grape fruit plants in December. Fifteen trees are being used and these are divided into three groups as follows :

5 trees sprayed with $\frac{1}{2}\%$ sulfinette weekly.

5 trees sprayed with 1% sulfinette fortnightly.

5 trees control (unsprayed).

Notes on the incidence of diseases and pests on each tree were made by the Mycologist before starting the experiment.

OIL YIELDING TREES

The recent planting of *Taraktogenos Kurzii* and *Aleurites montana* in the terraced valley has been very successful. No vacancies have occurred among the *Taraktogenos* and only six in the *Aleurites*. The final number of trees growing at the end of the year was as follows :

Taraktogenos Kurzii in block A,	...	132
,, ,, in block C,	...	133
	Total	265
Aleurites montana in block B,	...	30

Sixty-one seeds of *Aleurites montana* from the only tree in bearing on the station were sown in bamboo pots on November 3rd and these seeds began to germinate about six weeks later. The seedlings will be used for planting in further holes prepared in block B of the terraced valley.

THE ANNUAL ECONOMIC AREA

It was decided in November to discontinue the nitrification experiment which has been in progress for three years in the five quarter-acre plots of this area. Consequently the sugar cane and *Tephrosia candida* used for this experiment were uprooted in December. It is proposed next year to grow an acre of sorghum for cattle food in part of the area which will be rendered vacant.

TUBERS

Six varieties of cassava which are being maintained for stock purposes were dug in plots 19 B and C after replanting cuttings in plot 18 D.

THE IRIYAGAMA DIVISION

Favourable planting weather continued during November and budded stumps were planted out continuously in areas 2 and 7 as the buds sprouted. At the end of that month there were only a few plants still to go out in area 2 and a rather larger number in area 7, for which the budding was done later. The continuance of good planting weather was considered doubtful and it was decided to complete the planting in both areas whether the buds had sprouted or not. This decision proved extremely fortunate as December was exceedingly dry and no planting would have been possible.

A consignment of 103 budded stumps of AVROS 256 was received in November and these were planted in good weather. Sixty plants were planted in the plots allotted to this clone in area 7, while the remaining forty-three were planted in the nursery for budwood multiplication. The stumps arrived in excellent condition.

All the young budded plants in areas 2 and 7 were manured with sulphate of ammonia at the rate of ½ lb. per plant.

Over the greater part of the land not yet included in any area the young rubber trees were uprooted in November. Although it might have been possible to bud these trees next year there are a fair number of vacancies and it was thought that the difference in size of stocks used to fill these vacancies and the larger original trees would be so great as to vitiate comparison.

In area 3 it was observed that the buds of some clones appeared to shoot much more rapidly than others and it was decided to test this point by counting the number of buds of the original budding which had shot exactly five months after budding. At the end of December only six clones had passed the five-month period. The results in these clones were as follows :

Clone	Percentage of buds of the original budding which had sprouted five months after budding.
H 2	64·6
H 401	31·3
H 439	83·0
U. D. 24	58·0
M 162	50·0
H C 34	75·0

The size of all the stocks was much the same and as there was little difference between the actual five-month periods in each case the differences cannot be ascribed to weather conditions. The condition of the budwood doubtless varied, but this would be more likely to affect the percentage of successes obtained than the rate of sprouting of successfully budded plants. The indication is that quick sprouting is a clonal characteristic.

T. H. HOLLAND,
Manager,
Experiment Station,
Peradeniya.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED 31st JANUARY, 1931

Province, &c.	Disease	No. of Cases up to Date since Jan. 1st 1931	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	47	47	3	29	12	3
	Foot-and-mouth disease	20	20	...	...	20	...
	Anthrax	...	...	...	...	...	...
	Rabies	1	1 *	...	...	...	...
	Piroplasmosis	...	...	...	...	...	...
Colombo Municipality	Rinderpest	..	...	...	...	...	...
	Foot-and-mouth disease	56	56	24	...	32	...
	Anthrax	1	1 †	...	1	...	...
	Rabies	...	...	...	...	...	...
	Haemorrhagic Septicaemia	...	...	...	...	...	...
	Black Quarter	...	...	...	...	...	...
	Bovine Tuberculosis	...	...	...	...	...	
Cattle Quarantine Station	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	...	..	...	...	...	...
	Anthrax (Sheep and Goats)	24	24	...	24	...	...
Central	Rinderpest Foot-and-mouth disease Anthrax (Sheep) Piroplasmosis Rabies (Dogs)	FREE					
Southern	Rinderpest	...	..	...	...	...	...
	Foot-and-mouth disease	143	143	93	...	50	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	..
Northern	Rinderpest Foot-and-mouth disease Anthrax Black Quarter Rabies (Dogs)	FREE					
Eastern	Rinderpest Foot-and-mouth disease Anthrax	FREE					
North-Western	Rinderpest	1115	1115	11	986	12	106
	Foot-and-mouth disease	...	...	...	...	..	...
	Anthrax	...	...	...	..	...	...
	Pleuro-Pneumonia (in Goats)	...	...	...	...	...	...
North-Central	Rinderpest	1021	1021	81	875	65	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	...	...	...	...	...	...
Uva	Rinderpest	...	...	...	...	...	...
	Foot-and-mouth disease	1	1	1	...	...	...
	Anthrax	...	...	...	...	...	...
	Rabies (Dogs)	...	...	...	...	...	...
Sabaragamuwa	Rinderpest	...	...	..	...	...	...
	Foot-and-mouth disease	...	...	...	...	...	...
	Anthrax	..	...	...	...	...	...
	Piroplasmosis	1	1	...	...	1	...
	Rabies (Dogs)	1	1	...	...	...	1

* (A cow). † (a cow).

G. V. S. Office,
Colombo, 9th February, 1931.

G. W. STURGESS,
Government Veterinary Surgeon.

METEOROLOGICAL REPORT

JANUARY, 1931

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Inches		Inches
Colombo -	87·1	+1·2	72·6	+1·4	71	88	5·6	4·25	11	+ 0·35
Puttalam -	84·8	+0·3	70·0	+0·7	74	95	6·2	4·44	11	+ 1·66
Mannar -	84·1	+1·1	74·3	+0·7	74	86	5·6	4·15	12	+ 1·34
Jaffna -	82·1	+0·4	70·9	−1·1	77	93	5·4	7·47	12	+ 4·59
Trincomalee -	80·5	−0·3	74·7	+0·4	79	86	7·1	20·67	14	+14·02
Batticaloa -	80·9	−0·3	73·5	+0·6	81	90	7·9	16·99	19	+ 6·74
Hambantota -	84·9	+0·2	72·3	+0·3	76	90	5·0	6·67	11	+ 3·28
Galle -	83·2	−0·1	73·3	+0·6	80	95	6·2	9·10	15	+ 4·95
Ratnapura -	88·3	+1·4	72·5	+0·8	74	95	6·4	9·09	17	+ 3·54
A'pura -	82·4	−1·8	68·4	−0·4	78	92	6·4	8·32	9	+ 4·37
Kurunegala -	86·3	+0·5	71·1	+1·6	72	90	6·8	6·00	11	+ 2·19
Kandy -	81·7	+0·4	67·9	+1·4	70	87	6·1	7·86	15	+ 2·52
Badulla -	75·6	−0·7	64·6	+1·3	72	96	7·4	12·50	19	+ 2·95
Diyatalawa -	71·6	+0·4	58·3	+1·2	84	97	7·3	9·41	18	+ 3·46
Hakgala -	66·5	−0·6	52·5	+1·7	88	91	5·6	19·30	21	+ 9·29
N'Eliya -	68·1	+1·8	48·4	+1·9	75	93	6·0	9·58	16	+ 3·81

The rainfall of January was on the whole above average, though small deficits were frequent on the western side.

The excess in the total for the month was well marked throughout the N.P., E.P., and S.P., in the northern half of Uva and the eastern half of the C.P. In the N.C.P. it was consistent, but not of great amount. Small deficits predominated in the W.P. and Sab., in the southern parts of the N.W.P. and Uva, and in parts of the C.P.

The highest totals were 44·05 inches at St. Martin's (Upper), 43·17 at Hendon and 41·56 at Ledgerwatte. The lowest was 1·87 at Berna (N.W.P.).

The heaviest rain occurred during the middle of the month, notably from the 12th to 18th, when falls of over 5 inches in a day were far too common to mention individually. Falls of over 8 inches in a day were recorded at Kiran and Kirimutty (on the east coast, north of Batticaloa) on the 14th, and falls of over 7 inches at St. Martin's (Rangalla) and Tirrukovil. From the 23rd onwards very little rain was recorded anywhere.

Temperatures were on the whole above average, though there was a general fall in night temperatures at the end of the month, and the Nuwara Eliya minimum in air got down to 31·5° on the 31st.

The average wind movement for the month was slightly above average at all stations, though there was little to report in the way of gusts of exceptional violence. Humidity did not differ greatly from average, but the amount of cloudiness was consistently above average and the duration of bright sunshine as consistently below.

A. J. BAMFORD,
Superintendent, Observatory.